MARCH 20, 1991

SAVE
ARMY
ENERGY

ENERGY SAVINGS OPPORTUNITY SURVEY
FT. EUSTIS, VIRGINIA
CONTRACT NO. DACA31-89-C-0119

EXECUTIVE SUMMARY
PREFINAL REPORT
SCOPE of WORK
and
INTERIM REVIEW COMMENTS

Prepared by

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ENERGY SAVINGS OPPORTUNITY SURVEY
FORT EUSTIS, VIRGINIA

CONTRACT NO. DACA31-89-C-0119

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APPENDICES

OPENING REMARKS

In October of 1989, Benatec Associates was awarded an "Energy Savings Opportunity Survey" at Fort Eustis, Virginia.

Fort Eustis is located at the mid-point of the Virginia peninsula in southeast Virginia. Fort Eustis is bounded by the James River to the west and the Warwick River to the east. Fort Eustis experiences a relatively mild winter and a warm humid summer. The close proximity of the James River, York River, Chesapeake Bay, and the Atlantic Ocean tend to influence the local weather. The weather at Fort Eustis is quite mild due to the latitude and the proximity to large bodies of water.

Fort Eustis, Virginia, is the home of the United States Army Transportation Center and School. Primary stationary training and housing is located on the northern one-third of the post. Field training is performed on the southern end of Fort Eustis. Felker Army Airfield is located in the central portion of the post. Three-fourths of the facilities studied were located in the northern portion of Fort Eustis. The remaining facilities evaluated in this report were located on Felker Army Airfield.

In order to understand how an "Energy Savings Opportunity Survey" works, a short discussion of the major tasks performed is required.

1. Possible energy savings retrofits are defined. These energy retrofits normally come from a previous Energy Engineering Analysis Program (EEAP) and any other energy studies which were performed at this installation. For the purpose of our study, an energy survey was conducted by the Department of Engineering and Housing (DEH). The results of this survey were a list of Energy Conservation Opportunities (ECOs). An ECO is defined as any physical change or operational revision that may result in the saving of energy. An example of a simple ECO would be adding insulation to the walls of a building.

2. A physical on-site survey was made and each ECO was investigated. The purpose of this survey is to verify and understand how each ECO can be accomplished and to confirm existing conditions. Drawings of all concerned buildings were obtained and field verified for accuracy. Information compiled from the drawings and field surveys was used for quantity inputs for energy savings calculations. Estimated construction costs of the energy saving retrofits were also derived from actual conditions found in the field. A total of 148 ECO's were investigated under this contract.

3. Energy savings for each ECO retrofit were calculated. This calculation was accomplished with the aid of the "TRACE 600 Version" computer program as distributed by the Trane Company. This program basically calculates the building energy use on an hourly basis and sums the hourly uses to get an annual energy consumption. Computer runs were made of the building as it

exists and with the retrofit ECO added to the building. The difference between these two numbers is the estimated energy saved if the retrofit were applied to the building.

4. Construction estimates to perform each ECO retrofit were calculated. Construction sketches concerning the methodology of applying each ECO were made to form a basis of the estimate to ensure accuracy. A material take-off method of estimating was used in lieu of the less accurate square foot costing method.

5. The final step to determine the feasibility of the ECO retrofits was to perform an economic analysis. The purpose of the economic analysis is to ensure that all ECO retrofits are economically feasible. Every ECO studied will save energy. This portion of the study ensures that monies spent to construct retrofits will be returned in a reasonable time period with dollars gained from energy savings. For example, money spent to replace a lighting system would not be feasible if it would take longer to regain the installation cost through energy savings than the expected life of this system.

The LCCID computer program was used to perform the economic analysis. The inputs for this program include retrofit costs, maintenance costs, reoccurring replacement costs, and energy savings costs. The output from this program is expressed in a SIR (Savings Investment Ratio) number. If this SIR number is greater than 1 then the

retrofit is feasible. Any number less than 1 is not economically feasible and cannot be funded under Energy Conservation Investment Program funding.

HANDOUT - ATTACHMENT "A"

FEASIBLE RETROFITS (SIR GREATER THAN 1)

This sheet that was just handed to you is a summary of the total energy survey that was performed at Fort Eustis. This sheet presents the feasible retrofits in order of highest SIR, first on the list. The bottom line of this survey is that for a total expenditure of $1,179,960, a yearly savings of $210,137 will be realized. These totals include all feasible SIRs and the identified similar buildings on the entire post. Corresponding MBTU savings = 24,363

One could consider the results of this energy survey disappointing in that a greater percentage of the identified ECOs did not have an SIR ranking of greater than one. A contributing factor to these results was that when DEH identified the ECOs to be studied, No. 6 fuel oil was the primary source of providing the heating and domestic hot water needs at Fort Eustis. At the onset of this study, DEH had the opportunity of converting from fuel oil to natural gas at a considerable cost savings. Our study was based upon natural gas being the primary source of fuel for most of the ECOs because that any retrofit changes made would be at the time that natural gas was actually being used.

FORT E[illegible]S ENERGY SURVEY
TOTAL SAVINGS AND SIR RANKINGS

	Building		Retrofit Bldg. Cost**	Energy/ Bldg. Save/Year	LCCID-SIR	Total Quantity	Index Page*	Total Retrofit Cost**	Total Energy Save/Year	LCCID-SPB, Years
1.	3308	LLC - Warehouse	$ 1,700	$ 2,376	16.11	1		$ 1,700	$ 2,376	0.72
2.	650	LIC - Toilets	1,000	874	10.05	1		1,000	874	1.15
3.	2743	LLC - Toilets	600	354	6.80	1		600	354	1.70
4.	414	Lower Steam Opp. Press	560	184	5.50	1		560	184	3.06
5.	3302	LTG Hangar	19,000	7,646	4.64	1		19,000	7,646	2.49
6.	2413	LTG Hangar	13,100	5,143	4.52	4	A	52,400	20,572	2.56
7.	2406	Infrared Heaters	32,900	8,495	4.37	1		32,900	8,495	3.89
8.	812	LIC Classrooms	1,900	673	4.09	16	B	30,400	10,768	2.83
9.	650	LIC Storage	600	191	3.66	1		600	191	3.16
10.	414	Fix Existing Insulation	2,100	410	3.27	1		2,100	410	5.15
11.	705B	LIC - Toilets	500	135	3.13	1		500	135	3.71+
12.	3308	Combination #1	13,900	2,916	2.75	1		13,900	2,916	4.78
13.	152	Wall Insulation	9,000	1,854	2.73	56	C	504,000	103,824	4.87
14.	2413	Combination #1	34,300	7,306	2.66	1		34,300	7,306	4.71
15.	2402	Infrared Heaters	32,000	4,174	2.15	1		32,000	4,174	7.69
16.	3302	Combination #1	60,500	9,985	2.10	1		60,500	9,985	6.08
17.	3302	Combination #2	64,400	10,248	2.04	1		64,400	10,248	6.31
18.	2102	Ceiling Insulation	1,800	272	2.01	37	D	66,600	10,064	6.65
19.	812	LIC - Stor(Cont.)	1,200	192	1.84	16	B	19,200	3,072	6.27+
20.	2102	Combination #1	5,000	625	1.69	37	D	185,000	23,125	8.03
21.	2413	Combination #2	61,900	8,207	1.66	1		61,900	8,207	7.57
22.	214	Ceiling Insulation	3,200	350	1.55	2	E	6,400	700	9.17
23.	2750	Dryvit - Windows	134,000	12,200	1.53	1		134,000	12,200	11.02
24.	2102	Wall Insulation	3,200	341	1.50	37	D	118,400	12,617	9.42
25.	2402	Combination #1	49,100	4,365	1.47	1		49,100	4,365	11.29
26.	3302	LTG - Toilets	1,200	141	1.36	1		1,200	141	8.52
27.	3308	Infrared Heaters	12,200	1,003	1.36	1		12,200	1,003	12.21
28.	2743	LLC - Corridor	2,100	214	1.17	1		2,100	214	9.83+
29.	3302	Roof Insulation	41,500	2,817	1.16	1		41,500	2,817	14.50
30.	2413	Hangar Door Strips	21,200	1,474	1.15	1		21,200	1,474	14.44
31.	2743	LLC - Shops	14,700	1,448	1.14	1		14,700	1,448	10.19+
32.	2413	Windows	27,600	2,022	1.08	1		27,600	2,022	13.70
33.	2715A	Infrared Heaters	26,900	1,653	1.07	1		26,900	1,653	16.33
34.	3302	Hangar Door Strips	3,900	241	1.07	1		3,900	241	16.26
35.	650	LIC - Vestibule	9,000	837	1.07	1		9,000	837	10.79+
36.	414	Insulation (Increase)	21,700	1,360	1.05	1		21,700	1,360	16.02
37.	2402	Hangar Door Strips	17,100	1,088	1.02	1		17,100	1,088	15.77
	GRAND TOTALS =					234 Projects;		$1,690,560	$279,106	6.1 Avg.

* NOTE: See index page reference for a complete listing of duplicate, or similar, buildings.
** NOTE: Construction Cost only; does not include SIOH and Design Cost; SPB = Simple Payback in Years.
\+ NOTE: Does not qualify for ECIP Funding - See LCCID Summary.

FORT EUSTIS ENERGY SURVEY

INDEX A

The following buildings are duplicates of each other:

Building No.	2319
Building No.	2333
Building No.	2345
Building No.	2413

Index "A" Total = 4 Buildings

INDEX B

The following buildings are duplicates of each other:

Building No.	802
Building No.	803
Building No.	804
Building No.	805
Building No.	808
Building No.	809
Building No.	810
Building No.	811
Building No.	812
Building No.	813
Building No.	814
Building No.	815
Building No.	817
Building No.	818
Building No.	819
Building No.	820

Index "B" Total = 16 Buildings

INDEX C

The following buildings are similar to each other:

Building No.	102
Building No.	103
Building No.	104
Building No.	105
Building No.	106
Building No.	108
Building No.	109
Building No.	110
Building No.	111
Building No.	113
Building No.	114
Building No.	115
Building No.	116
Building No.	118
Building No.	119
Building No.	120
Building No.	121
Building No.	122
Building No.	123
Building No.	124
Building No.	125
Building No.	127
Building No.	128
Building No.	129
Building No.	131
Building No.	132
Building No.	133
Building No.	134
Building No.	135
Building No.	136
Building No.	138
Building No.	148
Building No.	149
Building No.	150
Building No.	152
Building No.	154
Building No.	155
Building No.	156
Building No.	157
Building No.	159
Building No.	160
Building No.	161
Building No.	162
Building No.	164
Building No.	165
Building No.	166
Building No.	168
Building No.	169
Building No.	170

INDEX C
(Continued)

Building No.	171
Building No.	173
Building No.	174
Building No.	176
Building No.	177
Building No.	178
Building No.	179

Index "C" Total = 56 Buildings

INDEX D

The following buildings are similar to each other:

Building No.	2101
Building No.	2102
Building No.	2103
Building No.	2104
Building No.	2105
Building No.	2106
Building No.	2107
Building No.	2108
Building No.	2118
Building No.	2119
Building No.	2120
Building No.	2121
Building No.	2122
Building No.	2301
Building No.	2313
Building No.	2314
Building No.	2315
Building No.	2318
Building No.	2319
Building No.	2325
Building No.	2326
Building No.	2327
Building No.	2333
Building No.	2334
Building No.	2342
Building No.	2343
Building No.	2344
Building No.	2345
Building No.	2925
Building No.	2926
Building No.	2927
Building No.	2928
Building No.	2929

INDEX D
(Continued)

Building No.	2932
Building No.	2933
Building No.	2934
Building No.	2935

Index "D" Total = 37 Buildings

INDEX E

The following buildings are duplicates of each other:

Building No.	214
Building No.	215

Index "E" Total = 2 Buildings

Future considerations should be given to ECOs with SIRs close to the magic number "one" if natural gas prices rise drastically. We are presently in a state of rising fuel oil costs and historically, natural gas prices track the price of fuel oil. In the near future, more ECOs could be added to the feasible list if natural gas prices increase.

HANDOUT - ATTACHMENT "B"

The sheet you just received identifies ECOs with SIR numbers ranging from 0.75 to 1.00. If energy prices increase in the near future, we feel that these ECOs have a very good chance of becoming feasible. However, one must be careful when considering additional ECOs in the future for as energy costs rise, construction cost also inflate. The economic analysis should be repeated for all additional ECOs to prove that, in fact, the SIR did increase to greater than one.

Two areas of study that had surprising results are the modular offices in Building 1608 and the Telephone Exchange, Building 1387.

MODULAR OFFICES

Modular offices, for this discussion, are defined as office areas built within high roof type buildings such as warehouses. One such area that was studied is a portion of Building 1608.

FORT EUSTIS ENERGY SURVEY

POSSIBLE FUTURE CONSIDERATIONS[1]
(of Buildings Actually Studied[1])

	Building	Retrofit Bldg. Cost[2]	Energy/ Bldg. Save/Year	LCCID-SIR	Total Quantity	Total Retrofit Cost	Total Energy Save/Year	LCCID-Simple Payback, Years
1.	2715C Infrared	$ 24,100	$ 1,327	0.96	1	$ 24,100	$ 1,327	18.23
2.	2715E Infrared	24,100	1,327	0.96	1	24,100	1,327	18.23
3.	2715G Infrared	24,100	1,327	0.96	1	24,100	1,327	18.23
4.	2715I Infrared	24,100	1,327	0.96	1	24,100	1,327	18.23
5.	2715K Infrared	24,100	1,327	0.96	1	24,100	1,327	18.23
6.	2413 LTG Office/Shop	11,600	956	0.95	1	11,600	956	12.18
7.	2785 Solar Film	3,400	295	0.95	12	40,800	3,540	11.57
8.	1920 Wall Insulation	3,300	224	0.93	1	3,300	224	14.77
9.	2730 LIC Corridors	2,400	186	0.89	1	2,400	186	12.94
10.	2413 LTG Corridor	2,300	165	0.83	1	2,300	165	13.99
11.	27150 Infrared	19,900	931	0.82	1	19,900	931	21.45
12.	1012 Windows	14,500	804	0.82	1	14,500	804	18.09
13.	2406 Windows	79,700	3,988	0.77	1	79,700	3,988	20.06
14.	2730 LIC Offices	2,900	188	0.75	1	2,900	188	15.52
	GRAND TOTALS =			Projects =	25	$297,900	$ 17,617	

[1] For duplicate buildings, see Index F below.
[2] Construction cost only; does not include SIOH and design costs.

INDEX F

The following buildings are duplicates of each other:

Building No.	2753	Building No.	2785	Building No.	2792
Building No.	2755	Building No.	2787	Building No.	2794
Building No.	2757	Building No.	2789	Building No.	2796
Building No.	2759	Building No.	2791	Building No.	2798

Index "F" Total = 12 Buildings

Approximately one-third of this warehouse type structure was converted to office use. These offices have eight foot ceiling heights and are placed in an area having twenty-five feet of ceiling height. Energy misuse comes from heating and cooling a volume three times as large as normal in order to keep the occupants of the lower portion of this volume comfortable.

To solve this energy problem, it would appear the simplest exercise would be to install a new ceiling at the proper height for office use. However, this simple solution becomes complex when you consider the major changes that must be made to the existing mechanical and electrical systems.

The electrical distribution system for this area is a bus duct system installed above work areas at about the ten foot height level. Power cords drop from this bus duct to run office machines where required as there are no floor level receptacles. The lighting for this area is accomplished with rows of area lighting suspended from the roof. If a new ceiling were installed, the electrical power and lighting systems would have to be reworked.

Air conditioning for this area is provided by units located along the perimeter of this area. Short pieces of duct connected to the unit supply directs air over the entire occupied area. Gravity then allows the cool air to drop into this area. Heating of this area is accomplished by fan powered unit heaters located at the high roof that were left in place from the previous use. If a new ceiling were installed, supply and return ductwork would have to be added and a heating system applied to this ductwork.

The high cost of reworking the mechanical and electrical systems, for the installation of a new ceiling to save energy, prohibits projects such as this because of the low return on investment. It is our recommendation that any future office space built in high bay buildings be built with energy conservation in mind. Low ceilings should be installed to keep the conditioned volume at a minimum. Mechanical and electrical systems would then be designed to accommodate only the occupied volume, instead of the entire replacement of these systems required to retrofit an existing space.

TELEPHONE EXCHANGE

Building 1387, the Telephone Exchange Building, is one of the highest energy users per square foot of any building on the base. Our areas of study for this building included increasing ceiling and wall insulation. The computer runs in both cases indicated an increase in energy when insulation was added.

The reason for this increase in energy required is because of the great amount of heat generated by the equipment housed in this building. This building requires air conditioning in all twelve months of the year, because even on the coldest day, heat is generated within at a greater rate than heat is lost through the ceiling and walls. Addition of insulation would retard the inadequate heat loss, increasing the air conditioning load in the colder months. Insulation does help reduce the summertime air conditioning load, but the net twelve month energy usage is increased.

Because of the large energy consumption of this building, we looked at alternative methods to reduce this energy use. One method considered was to install mechanical equipment to provide wintertime cooling using outside cool air instead of running existing air conditioning equipment. From an energy standpoint, this would be a very attractive alternative. However, this method would be impractical because of the environment required within this building for the internal telephone equipment to function properly.

If outside air was used for wintertime cooling, a humidification systems would be required to keep the inside relative humidity above acceptable levels. A high efficiency filtration system would also have to be installed to treat the high quantities of outside air being introduced for cooling purposes. Both of the above systems have high maintenance costs associated with them.

Our firm has done extensive studies for Bell of Pennsylvania on similar type buildings. In all cases, it was found to be more economical to provide year-round air conditioning for these buildings in lieu of using outside air for cooling.

SLIDE PRESENTATION

The following slides are intended to give you an idea of the variety of buildings studied and the ECOs to be applied. Only buildings with feasible ECOs are shown.

Building No.	ECOs
152	Wall Insulation
2102	Ceiling and Wall Insulation
2402	Door Strips and Infrared Heaters
2413	Windows and Door Strips
2750	Dryvit - Windows
3302	Door Strips and Lighting Changes
214	Ceiling Insulation
414	Various Slides Showing Steam Distribution System

This has been an interesting study experience for Benatec and, hopefully, useful results were obtained. Gas fuel conversion by DEH implemented during this study saved considerable energy dollars at Fort Eustis and would have had a high SIR number if it would have been part of our study. If natural gas conversion would have been studied, more ECOs would have been feasible. However, energy dollar savings are already being realized from this conversion much sooner than if it would have been included in the study.

I would like to take this opportunity to thank the personnel at DEH, specifically Larry Chenkin and Terry Artrid, for their exceptional cooperation in aiding us during our field visits. Without their help, our on-site tasks would have been much more difficult.

Also the various people at the individual buildings we visited were quite helpful. They seemed quite concerned and interested that energy improvements were being planned and went out of their way to help provide us with the information we needed.

QUESTIONS?

EXECUTIVE SUMMARY

An Energy Savings Opportunity Survey has been conducted at Fort Eustis, Virginia. Actual field survey of the studied facilities was performed from October 1989 through December 1989. Architectural, electrical, and mechanical energy conservation opportunities were investigated in accordance with the Detailed Scope of Work.

Most Energy Conservation Opportunities had saving/investment ratios of less than one. Savings/investment ratios were determined in accordance with Energy Conservation Investment Program guidelines. When the savings/investment ratio is less than one projects are not economically feasible; therefore, most of the energy conservation opportunities that were studied cannot be funded under Energy Conservation Investment Program funding.

A copy of the summary report has been included with the Executive Summary. The summary report is organized in priority order as outlined in the Detailed Scope of Work. All pertinent information relative to any given energy conservation opportunity is listed in the summary report. The summary report presented herewith is supported by detailed reports in the Appendices.

The following areas are the most lucrative with regard to sufficiently reducing energy costs to offset the capital cost:

- Lighting
- Steam Distribution Systems
- Housing Units in the 2100 Block
- Building 3302 and 3308 Lighting Systems
- Selected Infrared Heater Systems

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use throughout the year.

Most of Fort Eustis is heated via above ground steam distribution systems. The steam distribution system served by Boiler House 414 was studied for the purpose of this report. Insulation integrity is of considerable importance in the steam distribution system due to the relatively high temperature of the system. The steam distribution systems at Fort Eustis can be made more effective with minor insulation upgrade projects.

A moderate amount of energy can be saved at the Family Housing Units in the 2100 Block by upgrading wall and ceiling insulation. The advantage of accomplishing two energy conservation opportunities at one time is that construction costs can be slightly reduced.

The lighting systems at Building 3302 and Building 3308 are over-lit and out of date. Considerable energy and demand charges can be saved at these facilities, see tabulation. No other buildings studied in this report were observed to have lighting systems like the lighting systems in these buildings. If other buildings at Fort Eustis have lighting systems like the systems in these buildings then considerable energy savings can be achieved.

The ECOs, considered for lighting, generally concentrated on more efficient fixtures and/or more efficient lamps and ballasts in existing fixtures.

Motion sensors and/or infrared sensors are generally designed for loads of less than 1000 watts. Larger loads can be controlled by adding relays or contactors. Several things make these devices have questionable value for Fort Eustis. In larger offices, modular office partitions have been installed and were being installed in more offices during this survey. These partitions tend to block the line of control for the sensors. In addition, military employees have a structure and discipline that can be used to keep lights off when areas are not in use. Admittedly, some people remain careless and do not turn lights off. It is difficult to predict how much energy can be saved by motion sensing devices but it must be far less than in similar civilian applications.

Timers and contactors have not been considered in many areas because of flexible schedules and the inherent military discipline which was discussed above.

In general, fluorescent fixtures on this facility have standard ballasts and "watt - miser" lamps. Many ECOs for this project consider changing this combination to "watt - miser" ballasts and "watt - miser plus" lamps. This combination reduces energy consumption for the fixture by about 17% and increases light output by about 2%. General Electric Company studies show this combination to have the lowest ownership and operating costs.

The use of infrared heating at numerous facilities will save energy. Infrared heating saves energy by reducing the space temperature while maintaining occupant comfort with infrared energy. Infiltration is also

reduced in buildings heated with infrared heaters as the temperature difference between inside and outside is reduced.

High efficiency motor studies were undertaken in the following locations:

- o Sewer Plant Wet Pit Pumps
- o Sand Pond Well Pumps
- o Building 650 Chiller Motor

All three of these applications require special motors. The sewer plant wet pit pumps and the sand pond well pumps require complete replacement of motor and pump. The chiller motor is a special motor made for the individual chiller. No economical motor retrofit methods have been identified at this time.

Studied energy conservation opportunities were not economically feasible for the following primary reasons:

- o Previous Energy Retrofits
- o Relatively Low Fuel Costs
- o High Construction Costs Relative to Energy Costs
- o Mild Climate

A number of energy conservation opportunities examined in this report have been implemented as a result of general facilities renovations. Benatec Associates performed a similar Energy Savings Opportunity Study at New Cumberland Army Depot. Comparing fuel costs, construction costs and climate at Fort Eustis versus New Cumberland Army Depot, we find the general cost of living at both locations to be similar. When the energy/ retrofit costs at the two sites are compared we find that construction costs

are slightly lower at Fort Eustis; however, energy costs are significantly lower at Fort Eustis.

Upon review of the climate differences between the two sites, we find that Fort Eustis is considerably warmer in the winter and only slightly warmer and more humid in the summer. Many of the energy conservation items studied at Fort Eustis would have been successful at New Cumberland Army Depot due to the more harsh winter and higher fuel costs.

63470

Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
**** PRIORITY 1 ****											
401	Clg.Insul.	AS-401.02	$41,400	NA	NA	NA	NA	NO (0.13)	89.59	15	$464
401	L.I.C. Office	NA	NA	NA	NA	ES-ABCD	$54,200	NO (0.49)	23.74	118	$2,291
401	L.I.C. Corridor	NA	NA	NA	NA	ES-ACD	$3,800	NO (0.59)	19.62	10	$194
401	L.I.C. Toilet	NA	NA	NA	NA	ES-CDE	$1,200	NO (0.02)	680.25	1	$2
643	Solar Heated.DHW.	NA	NA	NA	NA	NA	NA	NO (0.257)	NA	NA	NA
705A	L.I.C. Office/Conf.	NA	NA	NA	NA	ES-CDE	$39,000	NO(0.40)	28.77	73	$1,360
705A	L.I.C. Toilet	NA	NA	NA	NA	ES-CDEF	$1,600	NO(0.07)	158.64	2	$10
705A	L.I.C. Corr./Stair	NA	NA	NA	NA	ES-CDEF	$5,200	NO(0.41)	28.24	9	$185
705B	L.I.C. Classrooms	NA	NA	NA	NA	ES-ACD	$35,600	NO(0.43)	26.87	48	$1,330
705B	L.I.C. Library	NA	NA	NA	NA	ES-ACDF	$6,100	NO(0.40)	28.97	13	$211
705B	L.I.C. Offices	NA	NA	NA	NA	ES-ACDE	$59,200	NO(0.51)	22.45	133	$2,646
705B	L.I.C. Toilet	NA	NA	NA	NA	ES-CDEFL	$500	YES(3.13)	3.71	1	$135
705B	L.I.C. Corridor	NA	NA	NA	NA	ES-ACDEF	$7,600	NO(0.35)	33.24	16	$229
705B	L.I.C. Coffee Shop	NA	NA	NA	NA	ES-ACD	$600	NO(0.15)	74.48	1	$8
812	Clg.Insul.On Deck	AS-812.02	$47,500	NA	NA	NA	NA	NO (0.20)	70.32	93	$678
812	Clg.Insul.Sprayed	AS-812.03	$92,900	NA	NA	NA	NA	NO (0.11)	121.39	100	$768
812	Ventilation HTI	NA	NA	NONE	NONE	NA	NA	NO(0.00)	NA	NA	NA
x16 812	L.I.C. Classrooms	NA	NA	NA	NA	ES-I	$1,900	YES (4.09)	2.83	25	$673
812	L.I.C. Flt/Shwr/Wash	NA	NA	NA	NA	ES-CDEF	$4,500	NO (0.07)	154.66	5	$29
812	L.I.C. Corr/Stair	NA	NA	NA	NA	ES-CDFH	$4,000	NO (0.59)	19.60	12	$205
812	L.I.C. Bedrooms	NA	NA	NA	NA	ES-CDE	$4,200	NO (0.10)	116.68	6	$36
x16 812	L.I.C. Stor(cont.)	NA	NA	NA	NA	ES-CDEH	$1,200	YES (1.84)	6.27	10	$192
	NOTE: AIR TO AIR HEAT EXCHANGER FAILED AS ADDITIONAL FAN ENERGY EXCEEDS HEAT ENERGY SAVED [NOTE 1]										
	NOTE: HEAT EXCHANGER STUDIED IN BLDG 812 IN LIEU OF HEAT RECOVERY IN BLDG 1605 [NOTE 2]										
801	Test Fuel Sample	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
x1 414 STM	Thicker Insulation	NA	NA	MS-414-STM.0	$21,700	NA	NA	YES(1.05)	16.02	259	$1,360
x1 414 STM	Fix Exist.Insul.	NA	NA	MS-414-STM.0	$2,100	NA	NA	YES(3.27)	5.15	78	$410
414 STM	Hot Water System	NA	NA	MS-414-STM.0	$93,300	NA	NA	NO(0.27)	62.79	284	$1,491
x1 414 STM	Lower Oper. Press.	NA	NA	MS-414-STM.0	$560	NA	NA	YES(5.50)	3.06	35	$184

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Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
2715A	Wall Insulation	AS-2715A.02	$26,900	NA	NA	NA	NA	NO(0.15)	90.98	36	$297
2715A	Windows	AS-2715A.04	$72,500	NA	NA	NA	NA	NO(0.12)	138.60	106	$525
2715A	Infrared Heaters	NA	NA	MS-2715A.01	$26,900	NA	NA	YES(1.07)	16.33	438	$1,653
2715C	Wall Insulation	AS-2715C.02	$85,100	NA	NA	NA	NA	NO(0.01)	NA	10	$43
2715C	Windows	AS-2715C.04	$77,300	NA	NA	NA	NA	NO(0.15)	116.08	156	$668
2715C	Infrared Heaters	NA	NA	MS-2715C.01	$24,100	NA	NA	NO(0.96)	18.23	346	$1,327
2715D	Wall Insulation	AS-2715D.02	$18,500	NA	NA	NA	NA	NO(0.19)	66.62	19	$279
2715D	Windows	NO WINDOWS	NONE			[NOTE 3]				NA	NA
2715D	Infrared Heaters					[NOTE 16]					
2715E	Wall Insulation	AS-2715E.02	$61,800	NA	NA	NA	NA	NO(0.01)	NA		
2715E	Windows	AS-2715E.04	$75,100	NA	NA	NA	NA	NO(0.15)	116.08		
2715E	Infrared Heaters	NA	NA	NONE		NA	NA	NO(0.96)	18.23		
	NOTE: SIMILAR TO 2715C SIR DATA TAKEN FROM 2715C [NOTE 4]										
2715F	Wall Insulation	AS-2715F.02	$18,500	NA	NA	NA	NA	NO(0.19)	66.62		
2715F	Windows	NO WINDOWS	NONE	NA	NA	NA					
2715F	Infrared Heaters										
	NOTE: SAME AS 2715D SIR DATA TAKEN FROM 2715D [NOTE 4]										
2715G	Wall Insulation	AS-2715G.02	$40,200	NA	NA	NA	NA	NO(0.01)	NA		
2715G	Windows	AS-2715G.04	$44,200	NA	NA	NA	NA	NO(0.15)	116.08		
2715G	Infrared Heaters	NA	NA	NONE		NA	NA	NO(0.96)	18.23		
	NOTE: SIMILAR TO 2715C SIR DATA TAKEN FROM 2715C [NOTE 4]										
2715H	Wall Insulation	AS-2715H.02	$18,500	NA	NA	NA	NA	NO(0.19)	66.62		
2715H	Windows	NO WINDOWS	NONE	NA	NA	NA					
2715H	Infrared Heaters										
	NOTE: SAME AS 2715D SIR DATA TAKEN FROM 2715D [NOTE 4]										
2715I	Wall Insulation	AS-2715I.02	$44,700	NA	NA	NA	NA	NO(0.01)	NA	36	$297
2715I	Windows	AS-2715I.04	$37,200	NA	NA	NA	NA	NO(0.15)	116.08	106	$525

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Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
2715I	Infrared Heaters	NA	NA	NONE		NA	NA	NO(0.96)	18.23	438	$1,653
	NOTE: SIMILAR TO 2715C SIR DATA TAKEN FROM 2715C [NOTE 4]										
2715K	Wall Insulation	AS-2715K.02		NA	NA	NA	NA	NO(0.01)	NA		
2715K	Windows	AS-2715K.04		NA	NA	NA	NA	NO(0.15)	116.08		
2715K	Infrared Heaters	NA	NA	NONE		NA	NA	NO(0.96)	18.23		
	NOTE: SIMILAR TO 2715C SIR DATA TAKEN FROM 2715C [NOTE 4]										
27150	Wall Insulation	AS-27150.02	$18,500	NA	NA	NA	NA	NO(0.03)	474.33	9	$39
27150	Windows	NO WINDOWS	NONE	NA	NA	NA				NA	NA
27150	Infrared Heaters	NA	NA	MS-27150.01	$19,900	NA	NA	NO(0.82)	21.45	247	$931
2716A-0	Wall Insulation										
2716A-0	Windows		[NOTE 5]								
2716A-0	Infrared Heaters										
**** PRIORITY 2 ****											
304	Wall Insulation	AS-304.01	NA	[NOTE 6]							
304	Ceiling Insulation	AS-304.01	NA	[NOTE 6]							
304	Windows	AS-304.03	$30,400	NA	NA	NA	NA	NO(0.47)	29.98	130	$1,017
304	Windows-Anderson	AS-304.04	$6,500	NA	NA	NA	NA	NO(0.04)	323.57	2	$20
	NOTE: WALLS & CEILING PRESENTLY INSULATED [NOTE 6]										
152	Wall Insulation	AS-152.06	$9,000	NA	NA	NA	NA	YES(2.73)	4.87	177	$1,854
152	Ceiling Insulation	AS-152.02	$20,400	NA	NA	NA	NA	NO(0.30)	45.00	50	$455
152	Windows	AS-152.07	NA		[NOTE 17]					NA	NA
152	Heat Pumps/Oil Furnace	NA	NA	MS-152.01	$88,300	NA	NA	NO(0.00)ND	127.88	-106	$693
152	Heat Pumps/Gas Furnace	NA	NA	MS-152.02	$54,200	NA	NA	NO(0.17)ND	36.09	-106	$1,507
1920	Wall Insulation	AS-1920.04	$3,300	NA	NA	NA	NA	NO(0.93)	14.77	25	$224
1920	Ceiling Insulation	AS-1920.02	$1,200	NA	NA	NA	NA	NO(0.46)	34.92	7	$34
1920	Windows	AS-1920.05	NA	[NOTE 7]						NA	NA
	NOTE: WINDOWS PREVIOUSLY REPLACED [NOTE 7]										
2102	Wall Insulation	AS-2102.04	$3,200	NA	NA	NA	NA	YES(1.50)	9.42	32	$341

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Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
2102	Ceiling Insulation	AS-2102.02	$1,800	NA	NA	NA	NA	YES(2.01)	6.65	20	$272
2102	Windows	AS-2102.06	NA	[NOTE 8]						NA	NA
2102	COMBINATION #1	NA	$5,000	NA	NA	NA	NA	YES(1.69)	8.03	49	$323
	NOTE: WINDOWS PREVIOUSLY REPLACED [NOTE 8]										
	NOTE: COMBINATION #1 [NOTE 18]										
**** PRIORITY 3 ****											
861	Off.Wall Insul.Full	AS-861.03	$15,200	NA	NA	NA	NA	NO (0.14)	86.30	12	$177
861	Off.Wall Insul.Part.	AS-861.04	$7,700	NA	NA	NA	NA	NO (0.09)	156.55	6	$49
861	Stor.Wall Insul.	AS-861.05	$25,100	NA	NA	NA	NA	NO (0.03)	557.50	12	$45
833	Wall Insulation	AS-833.02	$10,900	NA	NA	NA	NA	NO (0.16)	99.59	22	$110
2402	Wall Insul.	AS-2402.02	$22,500	NA	NA	NA	NA	NO(0.53)	31.96	135	$707
2402	Hangar Door Strip	AS-2402.06	$17,100	NA	NA	NA	NA	YES(1.02)	15.77	182	$1,088
2402	Infrared Heaters	NA	NA	MS-2402.01	$32,000	NA	NA	YES(2.15)	7.69	638	$4,174
2402	COMBINATION #1	NA	17,100.00	NA	$32,000	NA	NA	YES(1.47)	11.29	684	$4,236
	NOTE: COMBINATION #1 [NOTE 18]										
2407	New Double Pane	AS-2407.02	$9,400	NA	NA	NA	NA	NO (0.30)	54.82	28	$172
2407	Glazing Panel	AS-2407.03	$3,200	NA	NA	NA	NA	NO (0.68)	24.96	22	$129
2418	Ceiling Insulation	----------			DONE			----------		NA	NA
	NOTE: CEILING ALREADY INSULATED [NOTE 9]										
2406	Wall Insulation	AS-2406.02	$105,900	NA	NA	NA	NA	NO(0.51)	31.70	444	$3,353
2406	Windows	AS-2406.04	$79,700	NA	NA	NA	NA	NO(0.77)	20.06	430	$3,988
2406	Infrared Heaters	NA	NA	MS-2406.01	$32,900	NA	NA	YES(4.37)	3.89	1015	$8,495
2406	L.L.C. Offices	NA	NA	NA	NA	ES-CDE	$12,300	NO(0.12)	95.42	0	$129
2406	L.L.C. Toilets	NA	NA	NA	NA	ES-CDE	$1,300	NO(0.08)	142.80	1	$9
2406	L.L.C. Corridor	NA	NA	NA	NA	ES-CDF	$600	NO(0.08)	148.46	1	$4

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Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
2413	Ceiling Insulation	AS-2413.04	$107,700	NA	NA	NA	NA	NO (0.19)	76.79	159	$1,407
2413	Wall Insulation	AS-2413.02	$53,900	NA	NA	NA	NA	NO (0.59)	25.58	341	$2,506
2413	Windows	AS-2413.06	$27,600	NA	NA	NA	NA	YES (1.08)	13.70	240	$2,022
2413	Hangar Door Strip	AS-2413.08	$21,200	NA	NA	NA	NA	YES (1.15) ND	14.44	278	$1,474
2413	Doors (NOT RUN)	AS-2413.09	$20,800	NA	NA	NA	NA	DONE		NA	NA
2413	LTG Hangar	NA	NA	NA	NA	ES-G	$13,100	YES (4.52)	2.56	245	$5,143
2413	LTG Toilet	NA	NA	NA	NA	ES-H	$1,300	NO (0.33)	34.62	6	$38
2413	LTG Corr/Stair	NA	NA	NA	NA	ES-H	$2,300	NO (0.83)	13.99	6	$165
2413	LTG Office/Shop	NA	NA	NA	NA	ES-CDEH	$11,600	NO (0.95)	12.18	50	$956
2413	COMBINATION #1	NA	$21,200	NA	NA	NA	$13,100	YES(2.66)	4.71	522	$3,037
2413	COMBINATION #2	NA	$48,800	NA	NA	NA	$13,100	YES(1.66)	7.57	565	$3,259

NOTE: HANGAR DOORS ARE PRESENTLY INSULATED (NOTE 10)

NOTE: COMBINATION #1 (NOTE 18)
NOTE: COMBINATION #2 (NOTE 18)

2730	Ceiling Plenum Ducts	AS-2730.01	$13,000	MS-2730.01	$15,800	NA	NA	NO(0.03)	426.91	-4	$37
2730	L.I.C. Classrooms	NA	NA	NA	NA	ES-DEL	$26,100	NO(0.65)	17.85	50	$1,468
2730	L.I.C. Offices	NA	NA	NA	NA	ES-DEL	$2,900	NO(0.75)	15.52	9	$188
2730	L.I.C. Toilets	NA	NA	NA	NA	ES-CDE	$1,300	NO(0.03)	142.80	1	$9
2730	L.I.C. Corridors	NA	NA	NA	NA	ES-ACDJ	$2,400	NO(0.89)	12.94	9	$186

NOTE: ARCHITECTURAL SKETCH AND ESTIMATE COVERED IN MECHANICAL SECTION

2785	Solar Film	AS-2785.02	$3,400	NA	NA	NA	NA	NO (0.95)	11.57	6	$295
2785	Vestibules	AS-2785.04	$14,000	NA	NA	NA	NA	NO (0.00)	NA	0	$0
2785	Vestibules - Rerun	AS-2785.04	$14,000	NA	NA	NA	NA	NO (0.32)	47.35	18	$297
2743	Windows				DONE (NOTE 11)					NA	NA
2743	L.L.C. Shops	NA	NA	NA	NA	ES-CDEJL	$14,700	YES(1.14)	10.19	67	$1,448
2743	L.L.C. Offices	NA	NA	NA	NA	ES-ACDE	$4,700	NO(0.44)	26.14	8	$180
2743	L.L.C. Toilets	NA	NA	NA	NA	ES-J	$600	YES(6.88)	1.70	15	$354
2743	L.L.C. Corridor	NA	NA	NA	NA	ES-H	$2,100	YES(1.17)	9.83	13	$214

NOTE: WINDOWS ARE MODERN HIGH QUALITY WINDOW SYSTEMS (NOTE 11)

2750	Wall Insulation	AS-2750.02	$322,100	NA	NA	NA	NA	NO (0.06) ND	294.64	276	$1,097
2750	New Double Pane	AS-2750.04	$807,000	NA	NA	NA	NA	NO (0.31) ND	54.18	3790	$14,498
2750	Glazing Panel	AS-2750.05	$278,300	NA	NA	NA	NA	NO (0.68) ND	24.78	2852	$11,270
2750	Dryvit-Windows	AS-2750.06	$134,000	NA	NA	NA	NA	YES (1.53) ND	11.02	3085	$12,201

Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
3302	Ceiling Insulation	AS-3302.02	$41,500	NA	NA	NA	NA	YES(1.16)	14.50	663	$2,871
3302	Hangar Door Strip	AS-3302.04	$3,900	NA	NA	NA	NA	YES (1.07)	16.26	63	$241
3302	LTG. Hangar	NA	NA	NA	NA	ES-G	$19,000	YES (4.64)	2.49	356	$7,646
3302	LTG. Classroom	NA	NA	NA	NA	ES-ACD	$2,700	NO (0.66)	17.65	4	$154
3302	LTG. Toilets	NA	NA	NA	NA	ES-CDE	$1,200	YES (1.36)	8.52	2	$141
3302	LTG. Corridor	NA	NA	NA	NA	ES-ACD	$300	NO (0.14)	82.59	1	$4
3302	LTG. Office	NA	NA	NA	NA	ES-ACD	$700	NO (0.16)	69.77	2	$10
3302	COMBINATION #1	NA	$41,500	NA	NA	NA	$19,000	YES(2.15)	6.08	892	$4,304
3302	COMBINATION #2	NA	$45,400	NA	NA	NA	$19,000	YES(2.04)	6.31	961	$4,567
	NOTE: COMBINATION #1 (NOTE 18)										
	NOTE: COMBINATION #2 (NOTE 18)										
3308	Wall Insulation	AS-3308.02	$12,800	NA	NA	NA	NA	NO(0.34)	47.55	50	$270
3308	Infrared Heaters	NA	NA	MS-3308.01	$12,200	NA	NA	YES(1.36)	12.21	166	$1,003
3308	L.L.C. Warehouse	NA	NA	NA	NA	ES-K	$1,700	YES(16.11)	0.72	111	$2,376
3308	L.L.C. Office	NA	NA	NA	NA	ES-ACD	$18,600	NO(0.36)	32.15	30	$580
3308	L.L.C. Toilets	NA	NA	NA	NA	ES-CDEFJ	$1,400	NO(0.14)	83.01	3	$17
3308	L.L.C. Corridor	NA	NA	NA	NA	ES-CDE	$2,800	NO(0.10)	118.42	4	$24
3308	COMBINATION #1	NA	NA	NA	$12,200	NA	$1,700	YES(2.75)	4.78	239	$1,503
	NOTE: COMBINATION #1 (NOTE 18)										
1615	High Efficacy Motors	NA	NA		[NOTE 12]					NA	NA
00	Hines Circ. Pump	NA	NA		[NOTE 13]					NA	NA
**** PRIORITY 4 ****											
214	Ceiling Insulation	AS-214.02	$3,200	NA	NA	NA	NA	YES (1.55)	9.17	51	$350
231	Ceiling Insulation	AS-231.02	$32,700	NA	NA	NA	NA	NO (0.49)	28.97	113	$1,133
650	Roof Insulation	AS-650.02	$158,300	NA	NA	NA	NA	NO(0.70)	17.18	904	$9,244
650	L.I.C. Recreation	NA	NA	NA	NA	ES-ACDE	$20,100	NO(0.58)	19.76	61	$1,021
650	L.I.C. Offices	NA	NA	NA	NA	ES-ACDE	$1,500	NO(0.15)	77.60	3	$19

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Ft.Eustis - Weekly Status & Schedule

Bldg.#	Energy Items (ECOs)	Arch. Scheme	Arch. Est.	Mech. Scheme	Mech. Est.	Electr. Scheme	Electr. Est.	ECO Viable (SIR)	SPB (years)	Million BTU saved per year	Dollars saved per year
650	L.I.C. Toilets	NA	NA	NA	NA	ES-J	$1,000	YES(10.05)	1.15	56	$874
650	L.I.C. Corr./Vest.	NA	NA	NA	NA	ES-ACDEJ	$9,000	YES(1.07)	10.79	50	$837
650	L.I.C. Stor./Jan.	NA	NA	NA	NA	ES-CDEJ	$600	YES(3.66)	3.16	10	$191
650	L.I.C. Skating/Stage	NA	NA	NA	NA	ES-ACD	$5,100	NO(0.52)	22.07	16	$232
1012	Ceiling Insulation	AS-1012.02	$10,700								
1012	Wall Insulation	AS-1012.04	$12,100	NA	NA	NA	NA	NO (0.26)	$2.88	23	$230
1012	Windows	AS-1012.05	$14,500	NA	NA	NA	NA	NO (0.82)	18.09	110	$804
1387	Ceiling Insulation	AS-1387.02	$19,300	NA	NA	NA	NA	NO (-0.03)	NA	-3	($51)
1387	Wall Insulation	AS-1387.04	$61,900	NA	NA	NA	NA	NO (-0.01)	NA	-3	($30)
1605	Heat Reclaimation	---------- CIL [NOTE 14] ----------								NA	NA
	NOTE: COMMISSARY IS IN PROCESS OF RELOCATION [NOTE 14]										
1608A	Ceiling Insulation	AS-1608A.02	$77,100	NA	NA	NA	NA	NO(-0.05)	NA	-52	($432)
1608A	Wall Insulation	AS-1608A.04	$136,200	NA	NA	NA	NA	NO(0.08)	196.04	156	$697
1608A	Windows	AS-1608A.06	$21,800	NA	NA	NA	NA	NO(0.32)	51.20	111	$427
1608A	Supply Center LTG	NA	NA	NA	NA	ES-DEL	$3,300	NO(0.68)	17.00	10	$195
1608A	C.I.F. Warehouse LTG	NA	NA	NA	NA	ES-DEL	$2,900	NO(0.72)	16.17	8	$180
1608A	Toilet LTG	NA	NA	NA	NA	ES-J	$100	NO(0.00)	NA	0	$0
1608B	Ceiling Insulation	AS-1608B.02	$41,900	NA	NA	NA	NA	NO(0.06)	247.71	18	$170
1608B	Wall Insulation	AS-1608B.04	$98,500	NA	NA	NA	NA	NO(0.15)	92.57	103	$959
1608B	Windows	AS-1608B.06	$12,900	NA	NA	NA	NA	NO(0.26)	68.32	33	$189
1608B	Modular Office	AS-1608B.08	$116,200	MS-1608B.01	NA	ES-1608B.01	NA	NO(0.22)	57.48	151	$2,029
	NOTE: ALL MODULAR OFFICE ESTIMATES ARE COVERED IN ARCHITECTURAL SECTION										
1721	Ceiling Insulation	---------- CIL [NOTE 15] ----------								NA	NA
	NOTE: CEILING INSULATION ALREADY INSTALLED [NOTE 15]										

TOTALS FOR ALL RECOMMENDED ECOs, TAKING INTO ACCOUNT COMBINATIONS & DUPLICATE (SIMILAR) BUILDINGS 21,371 184,284

Page P-4 states yearly savings of #210,137 ea. $\frac{210,137}{184,284} = 1.14$.

Correct MBTU savings: (21,371)(1.14) = 24,363.

SUMMARY REPORT NOTES

NOTE 1 Air to air heat exchanger failed to qualify as fan energy required to cross heat exchanger exceeds heat energy saved.

NOTE 2 Consultant agreed to study heat exchanger in Building 812 in lieu of heat recovery in Building 1605. Building 1605, Commissary, is in process of moving to new location.

NOTE 3 This facility does not have windows.

NOTE 4 The construction, orientation, and occupancy of this facility is similar to the facility noted.

NOTE 5 The buildings that make up the 2716 complex are similar to the facilities that make up the 2715 complex. The individual facilities of 2716 were not computer evaluated on an individual basis as the environmental characteristics are similar to the four sample spaces evaluated in the 2715 complex.

NOTE 6 The contract documents indicate that this facility requires wall and ceiling insulation studies. During field surveys, this facility was found to have sufficient wall and ceiling insulation.

NOTE 7 Windows have been replaced between time of contract and time of survey.

NOTE 8 Windows have been replaced between time of contract and time of survey.

NOTE 9 The contract documents indicate that this facility requires ceiling insulation. During the survey of this facility, we found 6" fiberglass batt ceiling insulation.

NOTE 10 Hangar doors are presently insulated, where accessible. Core drilling was not permitted.

NOTE 11 Facility presently has second pane high quality storm windows.

NOTE 12 Replacement of chiller motors is not economically feasible as no industry standard high efficiency motors are available for mounting on existing chillers. If higher efficiencies are desired entire chiller must be replaced.

NOTE 13 Same conditions apply to well pump as to chillers noted in NOTE 12.

NOTE 14 See NOTE 2 and Building 812. Commissary is in process of relocation.

NOTE 15 Facility presently has 6" fiberglass ceiling insulation installed.

NOTE 16 Facility is a classroom with desks and chairs and is not suitable for conversion to an infrared heating system.

NOTE 17 Facility presently has second pane high quality storm windows.

NOTE 18 See included description of synergistic combinations.

DESCRIPTION OF SYNERGISTIC COMBINATIONS

Building 2102		
Combination No. 1	Ceiling Insulation and Wall Insulation Combined	Total Cost $ 5,000
Building 2402		
Combination No. 1	Hangar Door Strip and Infrared Heater	Total Cost $49,100
Building 2413		
Combination No. 1	Reduced Lighting and Hangar Door Weatherstrip	Total Cost $34,300
Combination No. 2	Reduced Lighting, Hangar Door Weatherstrip, and DSB Storm Glazing	Total Cost $61,900
Building 3302		
Combination No. 1	Reduced Lighting and Ceiling Insulation	Total Cost $60,500
Combination No. 2	Reduced Lighting, Ceiling Insulation, and Hangar Door Weatherstrip	Total Cost $64,400
Building 3308		
Combination No. 1	Reduced Lighting Level and Infrared Heaters	Total Cost $13,900

$289,100

INTRODUCTION

An Energy Savings Opportunity Survey has been conducted at Fort Eustis, Virginia. Actual field survey of the studied facilities was performed from October 1989 through December 1989. Field survey reports are included in Appendix B. Architectural, electrical, and mechanical energy conservation opportunities were investigated in accordance with the Detailed Scope of Work. Upon completion of the field surveys concept designs were developed to document the energy conservation opportunity retrofit items.

Based on the completed concept designs, energy analyses were performed. Electrical system analyses were performed using in-house spreadsheet computer programs. Electrical analysis calculations are included in Appendix D. Mechanical system analyses were performed using the Trane "TRACE" building energy analysis computer programs. Mechanical system load calculations are included in Appendix F. Preliminary estimates were prepared based on the concept designs. Electric demand output data from system analyses were adjusted to coincide with historic electrical demand.

Upon completion of electrical demand adjustment, fuel costs analyses, and preliminary estimates, the savings/investment ratio was calculated with the Life Cycle Cost in Design (LCCID) computer program.

Most Energy Conservation Opportunities (ECOs) had saving/investment ratios (SIR) of less than one. Savings/investment ratios were determined in accordance with Energy Conservation Investment Program (ECIP) guidelines. When the savings/investment ratio is less than one projects are not

economically feasible; therefore, most of the energy conservation opportunities that were studied cannot be funded under Energy Conservation Investment Program funding.

SIR summary data is included in the front of Appendix A and detailed SIR support data, LCCID computer output, is included in the back of Appendix A. Demand adjustment calculations are included in Appendix A. Building data is in numerical order per building number in all appendices.

FUEL COSTS

Fuel costs used in this report were current as of November 2, 1989. During the period of this report fossil fuel costs have fluctuated significantly. The adjusted costs of fuel will eventually effect the viability of ECO projects with SIRs greater than 0.80. The raw fuel costs used on this project are included in Table 1. Detailed derivation of as used fuel costs are included in Appendix G.

Liquid fossil fuel data, costs and heat value, were provided by the Fort Eustis Energy Branch. The following energy additional cost support data is included in Appendix G:

- Natural Gas Rate Schedule
- Electric Rate Schedule
- Electric Demand Summary

TABLE 1

RAW FUEL COSTS AT FORT EUSTIS, VIRGINIA

Electric KWH	$ 0.02165
Electric PKW	$10.78
Electric MMBTU	$ 6.34
No. 4 Fuel Oil MMBTU	$ 3.67
No. 2 Fuel Oil MMBTU	$ 4.69
Natural Gas MMBTU	$ 2.67

LIGHTING SYSTEM ENERGY CONSERVATION OPPORTUNITIES

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use of lighting throughout the year.

Lighting system analyses were based on design criteria as outlined in Paragraph 3-7 of Army Regulation 11-27, Army Energy Program dated 14 July 1989. The general summary guidelines are as follows:

- o Work Stations 50 Footcandles
- o Working Areas 30 Footcandles
- o Non-Working Areas 10 Footcandles

Detailed electrical analyses are included in Appendix D. Special note should be made of the fact that at a few locations existing lighting levels do not conform to existing lighting level requirements. Where lighting levels are below the standards outlined in AR 11-27 concept lighting design was based on matching existing lighting levels with more energy efficient lamp and ballast combinations.

Of the lighting systems studied in this report, the lighting systems in Building 3302 and Building 3308 are of special note. The lighting systems in these buildings are over-lit and out of date. Considerable energy and demand charges can be saved at these facilities. No other buildings studied in this report were observed to have lighting systems like the systems in these buildings. If other buildings at Fort Eustis, not included in this report, have lighting systems like, or similar to, the lighting systems in Building 3302 and Building 3308 then considerable energy savings can be achieved.

Building 401, ATL Administration - This building now uses fluorescent fixtures with standard ballasts and "watt miser" lamps. This system is poorly maintained but is supplemented with desk lamps. The ECOs consider retaining the desk lamps but changing the lamps and ballasts in the ceiling fixtures.

Building 650, Enlisted Service Club - This building now uses fluorescent fixtures with standard ballasts and "watt - miser" lamps. The building has fair maintenance. The building has large spaces and flexible hours of use. The building would have some use for motion sensors but there would be a large amount of rewiring to use them. The building is staffed during hours of use and the staff should be required to keep constant control of lighting. Some consideration must be given to atmosphere in this building. If a particular area is dark, it will not be inviting and not be used as heavily as it should. The ECOs for this building consider changing the lamps and ballasts in the ceiling fixtures.

Building 705, Transportation School & Administration - This building has very good maintenance. Nearly every fixture in this building is fluorescent. The ECOs consider large amounts of energy savings through changing lamps and ballasts. Individual discipline can save the use of fixtures in unoccupied areas without the need for added equipment.

Building 812, Barracks - This building has fair maintenance. The ECOs consider changing lamps and ballasts. Auxiliary areas of the building have incandescent fixtures now in use. The ECOs consider changing these to fluorescent. Bedroom lighting should be controlled by the occupants under individual discipline. A motion sensor was considered for the bedrooms but was rejected. The installed cost for the motion sensor will be about $75.00. If energy costs continue about 2.2 cents per Kilowatthour, it would take 41,800 hours of use reduction to justify a sensor in each room. This is not reasonable.

Building 1608, Warehouse/Administration - This building presently has very poor lighting. The proposed ECOs for this building involve upgrading the lighting without increasing energy consumption. Additional ECOs have been proposed to install new lighting in a new ceiling which is part of an Architectural ECO.

Building 2406, Hangar and Shops - This building is partially occupied for a large portion of the 24 hour day. Whatever aircraft is being worked on determines the portion of the building requiring lighting. Timers would not be practical for this application. Motion sensors were not deemed practical because of fixture warm - up time. The employees cannot stop work for 5

minutes to allow fixtures to warm up each time they enter an area. Some manual control suggestions have been included with the ECOs. The ECOs for the building are for offices, toilets and storage areas.

Building 2413, Hangar and Shops - This building has some antiquated fixture lowering equipment. The gentlemen responsible for the building asked that the fixtures not be lowered. According to him, several have been smashed to the floor in the process of lowering. The Corps of Engineers has indicated that the lamps are 450 watt self ballasted mercury. General Electric Company Large Lamp Catalog shows that these lamps provide only 9,100 lumens. This is no better than an incandescent installation. These lamps do have a better lifespan than the incandescent fixtures. The ECOs for this building can provide significant energy savings by going to lower wattage high pressure sodium fixtures. The discussion presented previously for Building 2406, Hangar, fixtures also applies to this building.

Building 2730, O.C.S. Facilities (Classroom Building) - This building has poor quality lighting for classroom use. There is a large amount of glare from open fixtures. Instructors have little control over fixtures when they wish to use a VCR.

The ECOs presented for this building consider changing fluorescent lamps and ballasts. In order to utilize motion sensors in this building, it would be necessary to install contactors. It is felt that disciplined occupants can provide good savings without the need for these modifications.

Building 2743, Motor Pool Maintenance Building - This building is poorly maintained. It has inadequate illumination and cannot be utilized to its full potential. If this building is to be fully utilized, it must have the lighting upgraded. The ECOs address energy savings for fixtures now in use.

Building 3302, Applied Instruction - The hangar portion of this building uses a double fixture with 400 watt mercury and 450 watt self ballasted mercury lamps. These fixtures can be replaced to realize a large energy savings. Some additional savings can be realized in offices and classrooms with ECOs for fluorescent fixtures.

Building 3308, Applied Instruction - The warehouse portion of this building has too much illumination. Older style combination 400 watt mercury and incandescent fixtures had previously been replaced with 400 watt high pressure sodium fixtures. The ECOs for this building propose removal of some of the fixtures to reduce energy consumption. ECOs have also been proposed to change ballasts and lamps in fluorescent fixtures in corridor and office areas.

THERMAL ENVIRONMENTAL SYSTEM SIMULATION

Thermal environmental system analyses were performed with the Trane "TRACE" building energy analysis computer program. Two copies of the extended Trane "TRACE" documentation manuals have been forwarded to Fort Eustis and the Baltimore District of the Corps of Engineers.

Building simulations were performed to account for energy conditions that would effect the studied ECO. Evaluation of perimeter skin systems, such as wall insulation, was performed accounting for solar load gains/losses and internal load gains/losses and infiltration effect; however, non-effect loads such as ventilation or isolated process loads were not summarized. Ventilation is not included in most of the building simulations as the ventilation level will be the same before and after the retrofit and the ventilation heat load will not change.

Samples of simulation program input forms are included in Appendix H. One copy of Appendix H has been forwarded to Fort Eustis and one copy has been forwarded to the Baltimore District of the Corps of Engineers. In addition to the computer input forms, the following items are included in Appendix H:

- o Thermostat Schedules
- o Occupancy Schedules
- o Materials Listings
- o Wall/Roof Listings

Thermostat schedules were generated based on occupancy hours as reported by building users and set points as specified in AR 11-27. Occupancy schedules were generated based on occupancy hours and approximate numbers of people as reported by building users. The materials listing and the wall/roof listing includes all standard materials included with the computer software package, special materials observed during field surveys, and special materials generated during concept design.

Occupancy schedules are generally self-explanatory. The camel hump effect in the classroom lighting schedule, CRLTG in Appendix H, is caused by the variations in the way classrooms are utilized. During field surveys we observed that many times classrooms are used for a short period then training exercises are moved to a hands-on training location. The actual absolute classroom schedule cannot be simulated as it is highly dependent on student load and course scheduling. The idealized classroom schedule was based on discussions with military instructors and reasonable engineering judgements.

DETERMINATION OF BUILDING INFILTRATION

Considerable amounts of energy is consumed in buildings overcoming the thermal loads caused by infiltration. In addition to direct heat loss associated with infiltration, infiltration extracts stored heat in the winter when the building is in the night setback mode. The mass of a building with a high infiltration rate will cool to 55°F faster than a building with a low infiltration rate. When the mass of the building is cooled faster, night heating is required for more hours. The ideal heating building would store all heat in the building mass for use on subsequent days.

To account for the energy drain effect of building mass and general energy consumption due to infiltration, three basic infiltration conditions were utilized as follows:

- Base infiltration normal building.
- Base infiltration infrared heated building.
- ECO specific infiltration.

Calculated infiltration quantities were determined in accordance with guidelines and equations as presented in ASHRAE 1989 FUNDAMENTALS HANDBOOK, Chapter 23, Infiltration and Ventilation, and ASHRAE Group 158, COOLING AND HEATING LOAD CALCULATIONS MANUAL, Chapter 5, Infiltration and Ventilation. Infiltration calculations were prepared on special infiltration worksheet forms. Infiltration worksheets are included with the specific building "TRACE Input File" in Appendix F.

Base infiltration for normal buildings was broken down into the following four categories:

o Loose	One Air Change
o Medium	3/4 Air Change
o Tight	1/2 Air Change
o Energy Retrofit	Zero Infiltration

During field surveys, building construction and existing conditions were observed to make a judgement as to the infiltration category for specific buildings. A concrete block building with cracked block, large expanses of glass, and loose fitting window frames was classified as loose. Well constructed and maintained concrete block or steel sided buildings with moderate glass exposure and medium fit windows were classified as medium. If a building wall was well constructed and maintained with less than 50% glass per exposure the building was classified as tight. Buildings that had large mass and had recent energy retrofit to close construction cracks were classified as energy retrofit. Most buildings were classified as tight or medium for infiltration. Two facilities, Building 401 - Administration and Building 812 - Barracks, were classified as tight.

Base infiltration for infrared heated buildings was determined by adjusting the infiltration calculated to occur on the building in the present condition. Space temperatures in infrared heated buildings are lower than in conventionally heated buildings. With reduced temperature differentials between inside and outside the driving forces of the infiltration is reduced. To account for the reduction of infiltration in infrared heated buildings, infiltration was set at 75% of the infiltration of the conventionally heated building.

ECO specific infiltration is that infiltration that will change with the application of a specific ECO. An example of ECO specific infiltration is the comparison of infiltration of existing windows with infiltration with storm glazing over existing windows.

ELECTRIC DEMAND ADJUSTMENTS

Electrical demand charges are a significant portion of the energy budget an any non-residential energy consuming facility. Reducing electric demand does not necessarily reduce energy consumption. Reducing energy demand only reduces electric delivery costs. Reduction in demand at a particular building can only reduce total electrical costs if the building demand reduction occurs coincident with the peak electrical demand for the entire electric consuming facility, in this case all of Fort Eustis.

To insure that no excess demand credits were taken, building demand reductions associated with heated only buildings were evaluated, on an economic basis, as if no reduction in demand had occurred. Demand peaks at

Fort Eustis occur in July and August on weekday afternoons. Any major heating electrical demand generator would be off at the time of post peak demand. Post demand data is as listed in Table 2. Support source data for Table 2 is included in Appendix G.

TABLE 2

FORT EUSTIS ELECTRICAL DEMAND

Month	On Peak KW
January	14,138
February	14,530
March	15,160
April	13,358
May	15,935
June	21,470
July	21,712
August	21,786
September	20,072
October	17,256
November	12,746
December	14,630

Electric demand effect for specific buildings was adjusted for composite effect. The monthly electric demand for the base building was subtracted from the monthly electric demand listed in Table 2 to determine equivalent post demand without the studied building. Building retrofit demand was then added to the equivalent post demand on a month for month basis. After determination of the effect of ECO demand on the post electrical demand, the billing charges were calculated in accordance with the electric utility rate guidelines. Individual ECO demand calculations are included in Appendix A.

INFRARED HEATER SIMULATION

The use of infrared heating at numerous facilities will save energy. Infrared heating saves energy by reducing the space temperature while maintaining occupant comfort with infrared energy. Infiltration is also reduced in buildings heated with infrared heaters as the temperature difference between inside and outside is reduced.

The Trane "TRACE" building energy analysis computer program does not have a specific system simulation package that directly simulates infrared heaters. Infrared heaters were simulated by setting space thermostats at 55°F for 24 hours per day while the comparative base building is set up to 68°F during the occupied hours. The rationale for simulating infrared heaters in this manner is that as the heaters heat up the floor and furnishings, these items store thermal energy. As the thermal energy is stored, it is later released to the space causing secondary heating of the space. All studied facilities were treated with broad range coverage of IR heaters as no fixed work stations exist in any of the studied facilities. Under normal operating conditions in an IR heated building, the bulk space temperature approaches 55°F. Even if there is not an energy requirement to condition the space for occupants, minimal space heating is required to avoid freezing of building systems, i.e. sprinklers and water lines.

In addition to a reduction of heating required to maintain bulk temperature, IR heating requires less heating of infiltration air. Given the comparison of 55°F versus 68°F bulk air temperature, the energy savings per hour for 100 CFM of infiltration is 1,430 BTU/Hr.

The simulation method selected does not approximate the theoretically ideal conditions of IR heat controlled by black body thermostats. Simulation of IR heaters controlled by black body thermostats does not account for heat absorbed, stored, and released by building components and furnishings. Simulation of IR heaters controlled by black body thermostats does not account for the override setting of IR used to maintain bulk space temperature to avoid freezing.

In view of the drawbacks associated with both methods of simulating IR heaters, the more conservative approach was selected so that no energy saving credits were not counted that cannot actually be anticipated.

ESTIMATING

Upon completion of field surveys and concept designs, construction cost estimates were prepared in accordance with Appendix C of TM5-800-2, COST ESTIMATES - MILITARY CONSTRUCTION dated 12 June 85.

Estimate data was primarily taken from MEANS BUILDING CONSTRUCTION COST DATA. Data taken from Means was adjusted using the Means city cost indexes for Newport News, Virginia. Unit prices and labor manhours which were not available from Means were obtained from central Pennsylvania equipment suppliers and contractors.

Cost estimates for specific energy conservation opportunities are included in Appendices C, D, and E.

FUEL TEST ANALYSIS

Per the requirements of the Detailed Scope of Work, a fuel test sample was obtained at Boiler House 801. The fuel sample was subsequently sent to a laboratory for composition analysis. The laboratory test results are included in Appendix G. After completion of the laboratory test, Fort Eustis Energy Branch representatives indicated that there is some concern as to whether the fuel in the sample is a field mixed mixture of No. 2 and No. 5 or 6 fuel oil. The mixture concerns were not brought to the attention of the A/E at the time the sample was obtained. Fort Eustis representatives have taken a second representative fuel sample and have allowed the sample to separate over the past two months. We recommend that two samples be taken of the separated sample and these samples be sent in separate containers for further fuel analysis.

STEAM DISTRIBUTION SYSTEM

Most of Fort Eustis is heated via above ground steam distribution systems. The steam distribution system served by Boiler House 414 was studied for the purpose of this report. Insulation integrity is of considerable importance in the steam distribution system due to the relatively high temperature of the system. The steam distribution systems at Fort Eustis can be made more effective with minor insulation upgrade projects.

Detailed calculations relative to the steam distribution system are presented in Appendix G. Steam distribution calculations were performed by the degree day method. Degree day data used was for Langley Air Force Base,

Virginia. Degree day data is included in Appendix G. Degree day data was provided by Fort Eustis Energy Branch.

The steam distribution system served by Boiler House 414 was simulated at temperatures below 65°F as this particular steam system is shutdown at the end of the heating season. Insulation value data was obtained from Owens/ Corning for calcium silicate insulation systems with metal jackets. Base insulation values provided by Owens/Corning were prepared in accordance with ASTM Standard C680-89. Specific ambient and pipe temperature data was applied to the manufacturer's tabular data with in-house curve fitting computer subroutines. All calculations were performed in still air.

Some of the steam distribution systems at Fort Eustis are in worse condition and are more extensive then the system studied for this report. Given that this report is conservative on savings, due to not accounting for wind, we strongly recommend a future post-wide expanded steam system evaluation.

HIGH EFFICIENCY MOTORS

High efficiency motor studies were undertaken in the following locations:

- o Sewer Plant Wet Pit Pumps
- o Sand Pond Well Pumps
- o Building 650 Chiller Motor

All three of these applications require special motors. The sewer plant wet pit pumps and the sand pond well pumps require complete replacement of

motor and pump. The chiller motor is a special motor made for the individual chiller. No economical motor retrofit methods have been identified at this time.

CONCLUSION

The following areas are the most lucrative with regard to sufficiently reducing energy costs to offset the capital cost:

- Lighting
- Steam Distribution Systems
- Housing Units in the 2100 Block
- Building 3302 and 3308 Lighting Systems
- Selected Infrared Heater Systems

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use throughout the year.

Most of Fort Eustis is heated via above ground steam distribution systems. The steam distribution system served by Boiler House 414 was studied for the purpose of this report. Insulation integrity is of considerable importance in the steam distribution system due to the relatively high temperature of the system. The steam distribution systems at Fort Eustis can be made more effective with minor insulation upgrade projects.

Studied energy conservation opportunities were not economically feasible for the following primary reasons:

- o Previous Energy Retrofits
- o Relatively Low Fuel Costs
- o High Construction Costs Relative to Energy Costs
- o Mild Climate

A number of energy conservation opportunities examined in this report have been implemented as a result of general facilities renovations. Benatec Associates performed a similar Energy Savings Opportunity Study at New Cumberland Army Depot. Comparing fuel costs, construction costs and climate at Fort Eustis versus New Cumberland Army Depot, we find the general cost of living at both locations to be similar. When the energy/ retrofit costs at the two sites are compared we find that construction costs are slightly lower at Fort Eustis; however, energy costs are significantly lower at Fort Eustis.

Upon review of the climate differences between the two sites, we find that Fort Eustis is considerably warmer in the winter and only slightly warmer and more humid in the summer. Many of the energy conservation items studied at Fort Eustis would have been successful at New Cumberland Army Depot due to the more harsh winter and higher fuel costs.

SCOPE

OF

WORK

M E M O R A N D U M

63470/EM89-71

April 6, 1989

TO: File 63470

cc: Jim Hawk, COE Baltimore
Chuck Johnson, Benatec Associates
Alan Krammes, Benatec Associates

FROM: Hank Jongsma
Executive Vice President
Benatec Associates

Approved For:
BENATEC ASSOCIATES

Tomas H. Spiers, Jr., AIA
President

SUBJECT: FINAL NEGOTIATIONS

RE: Fort Eustis
Energy Analysis

On April 5, 1989, a negotiation meeting was held in the office of Benatec Associates, with the above listed persons in attendance.

The scope of work was discussed and the number of buildings to be investigated and analyzed was reduced from the original program. A list of buildings per priority is as follows:

Priority 1	Priority 2	Priority 3	Priority 4
401	304	861	214
643	152	833	231
705A	1920	2402	650
705B	2102	2407	1012
812		2418	1387
801		2406	1605
414		2413	1608A
2715A-0		2730	1608B
2716A-0		2785	1721
		2743	
		2750	
		3302	
		3308	
		1615	

Other discussions and decisions made are as follows:

- Shower restrictions are not to be included.
- Solar heat study (Building 643) is to be deleted.
- Separate calculations are not required for buildings similar in floor areas and usage.
- Estimates to be made for family housing units can be made on a per square foot basis. Heat pumps are deleted.
- Estimates of energy saving for family housing to indicate MBTU/SF.
- Calculations for family housing units to be for 2, 3 and 4 bedroom units, as appropriate.
- In case the Consultant will experience delay in accessibility to buildings, this would be cause for escalation of cost.
- In case existing drawings of buildings are not available or would require more than a minimal effort to update the floor plans, building elevations (windows) and wall sections, this would be cause for escalation of cost.
- Construction cost for the modular offices in Building 1608B can be based on a square foot price.
- Motor efficiency to be determined by approximation of motor age; no power factor reading required.
- Total negotiated fee for the project is $225,000.

HJ/b

CENAB-EN-IM

October 1986
Rev 2 Dated
April 1988
Rev 3&4 Dated
June 1988

GENERAL SCOPE OF WORK

FOR AN

ENERGY SAVINGS OPPORTUNITY SURVEY

FORT EUSTIS, VA

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

301-684-3033

SCOPE OF WORK
FOR AN
ENERGY SAVINGS OPPORTUNITY SURVEY
ENERGY ENGINEERING ANALYSIS PROGRAM
FORT EUSTIS, VA

TABLE OF CONTENTS

1. BRIEF DESCRIPTION OF WORK. The Architect-Engineer (AE) shall:

1.1 Review for general information the previously completed Energy Engineering Analysis Program (EEAP) study and any other energy studies which were performed at this installation.

1.2 Reevaluate selected projects and energy conservation opportunities (ECOs) from the previous studies to determine their economic feasibility based on revised criteria, current site conditions and technical applicability.

1.3 Evaluate selected ECOs to determine their energy savings potential and economic feasibility.

1.4 Perform a limited site survey of selected buildings or areas to insure that certain methods of energy conservation which may be practical and have not been evaluated in any previous energy study have been considered and the results documented.

1.5 Provide complete new programming or implementation documentation for all recommended ECOs.

1.6 Prepare a comprehensive report to document the work performed, the results and the recommendations.

2. GENERAL.

2.1 An EEAP study has been performed at this installation. Criteria for both the study and the resulting documentation has changed since the previous study was completed. This study is intended to reevaluate selected projects from the previous study which have not been implemented nor programmed for implementation and to consider specific ECOs in buildings and areas that may have been overlooked previously or recently identified.

2.2 The information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study.

2.3 The AE shall ensure that all methods of energy conservation listed in Annex A have been considered and documented. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination. This list shall be considered and the evaluation of each ECO documented in the report.

2.4 The study shall include the energy consuming buildings or areas listed in Annex A. The work in the areas may be reduced somewhat by building repetition.

2.5 The study shall consider the use of all energy sources. The energy sources include electricity, natural gas, liquified petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, solar, etc.

2.6 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAEN-MPO-U, 10 August 1982 and revised by letters from DAEN-ZCF-U, 4 March 1985 and 11 June 1986, establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 submission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP Index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP and MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.8 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.9 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

3. PROJECT MANAGEMENT.

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Director of Engineering and Housing at the installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the required presentations and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6. Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of materials.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Engineering and Housing before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall thoroughly brief and describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing.

3.7.2 Exit. The exit interview shall include a thorough briefing describing the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Engineering and Housing.

4. SERVICES AND MATERIALS. All services, materials, plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract shall be provided by the AE unless specifically noted to be furnished by the Government.

5. PROJECT DOCUMENTATION. All energy conservation opportunities (ECOs) which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000, a Savings to Investment Ratio (SIR) greater than one and a simple payback period of less than ten years. For family housing projects, the $200,000 limitation may not apply. The AE shall check with the installation for guidance. The overall project and each discreet part of the project shall have a SIR greater than one. For all projects meeting the above criteria, completed programming documentation will be required. Programming documentation shall consist of a DD Form 1391, Life Cycle Cost Analysis Summary Sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A Life Cycle Cost Analysis Summary Sheet shall be developed for each ECO and for the overall project when more than one ECO is combined.

5.2 Non-ECIP Projects. Projects which normally do not meet ECIP criteria, but which have an overall SIR greater than one shall be documented. The Life Cycle Cost Analysis Summary Sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they area feasible even if they do not meet ECIP criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the Life Cycle Cost Analysis Summary Sheet, completely

filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost not over $100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost not over $100,000 and a simple payback period of four years or less.

c. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of more than $100,000 and a simple payback period of four years or less.

The above programs are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of ten to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332.

e. Low Cost/No Cost Projects. These are projects which the Director of Engineering and Housing can perform using his resources.

5.3 Infeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The general Scope of Work is intended to apply to contract efforts for all Army installations included under this contract except as modified by the detailed Scope of Work for each individual installation. The detailed Scope of Work is contained in Annex "A".

7.3 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step procession from the first assumption to the final number. A Life Cycle Cost Analysis Summary Sheet shall be prepared for each ECO and included as part of the supporting data.

7.4 Perform a Limited Site Survey. The AE shall conduct a limited site survey to evaluate the buildings or areas listed in Annex A. The list of ECO's in Annex A shall be used when evaluating these buildings or areas. Each of the items shall be considered and discussed in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall obtain all the necessary data to evaluate the ECOs by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment used by the AE shall be properly calibrated within 20 days prior to its use. For ECOs which would replace the existing heating, ventilating, and air conditioning (HVAC) system or significantly change it (such as converting a multizone system to a variable air volume system) the AE is required to run a computer simulation to analyze the system and to determine the energy savings. This requirement to use computer modeling applies only to heated and air conditioned or air conditioned only buildings which exceed 8,000 square feet or heated only buildings in excess of 20,000 square feet. The computer program shall analyze the building on an hour-by hour basis rather than the bin data method or bin data to simulate an hour-by-hour analysis.

Unless the Building Loads Analysis and System Thermodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis. The computer progam used must be comparable to the BLAST program.

7.5 Provide Programming or Implementation Documentation. For projects or ECOs developed during this study, complete programming or implementation documentation shall be prepared by the AE.

7.5.1 Programming Documentation. For projects or ECOs which meet ECIP criteria and which the installation wants to submit as an ECIP project, complete programming documentation shall be prepared. Completed programming documentation consists of DD Form 1391, Project Development Brochure (PDB) and supporting data. These forms shall be separate from the narrative report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly.

7.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex B. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation personnel. All documents shall be completed except for the required signatures.

7.5.1.2 Project Development Brochure (PDB). Preparation of the PDB requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-1 format described in the TM shall be used for whatever information is needed.

7.5.1.3 Supporting Data. The AE shall provide all data and calculations needed to support the recommended project. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A Life Cycle Cost Analysis Summary

Sheet shall be prepared for each ECIP project and each discreet part of the project and included as part of the supporting data.

7.5.2 Implementation Documentation. For feasible projects or ECOs which normally do not meet ECIP criteria, implementation documentation shall be prepared. Each feasible project or ECO shall be individually packaged and fully documented and included as a separate section in the volume containing the programming documentation. Each project or ECO shall have a complete description of the changes required, economic justifications, sketches, and other backup data included as a section in the report. The documentation required will be as determined by the Government's representative. Documentation required will be in the categories listed in paragraph 5.2. For the QRIP, OSD PIF and PECIP projects, documentation shall be prepared in accordance with th requirements of AR 5-4, Change No. 1. A sample implementation document (DA Form 5108-R).shall be submitted for review and approval with the interim submittal. The sample shall have primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy saving data. For MCA projects, the documentation required shall be in accordance with paragraph 7.3 except that the economic analysis required by ETL 1110-3-332 shall be included in lieu of the ECIP Life Cycle Cost Analysis. For low cost/no cost projects which the Director of Engineering and Housing personnel can perform, the following information shall be provided:

a. Brief description of the project.

b. Brief description of the reasons for the modification.

c. Specific instructions for performing the modification.

d. Estimated dollar and energy savings per year.

e. Estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours shall be listed by trade. For projects that would repair an existing system so that is will functions properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications. Separate sheets for each project showing the above information shall be prepared and included in the report.

For projects which cannot be placed into one of the categories above, the AE shall prepare the documentation required by the Contracting Officer's representative.

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to installation, command, and other government personnel. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and a preliminary analysis has been performed on all of the ECOs' The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Preliminary calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes. A sample implementation document (DA Form 5108-R) for one non-ECIP project shall be submitted with this submittal for review and approval. The survey forms completed during the audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended tasks should be accomplished. The The synergistic effects of all the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming and

implementation documents for all recommended new projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal report, Executive Summary, and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include:

(a) a separately bound Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables, and charts as much as possible (see Annex C for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the Lify Cycle Cost Analysis Summary Sheet: the cost (construction cost plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the analysis date. For all programmed projects, also include the year in which it is programmed and the programmed year cost. The simple payback period should also be shown for these projects and ECOs.

7.6.3 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of the complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

ANNEX A

Detailed Scope of Work

for an

Energy Savings Opportunity Survey

at

Fort Eustis, VA

Pages A-1 thru A-11

The following detailed requirements amplify, modify or add to the referenced paragraphs of the General Scope of Work for the subject study.

1. 2.6 Use an SIOH value of 5.5% in ECIP Guidance, Life Cycle Cost Analyses.

2. 3.0. Add the following:

Point of contact at Ft. Eustis is: Commander,
U.S. Army Transportation Center
ATTN: ATZF-EHW (Mr. Chenkin)
Fort Eustis, VA 23604-5333

Point of contact at Baltimore District is: Corps of Engineers,
P.O. Box 1715
ATTN: CENAB-EN-IM (James Hawk)
Baltimore, Maryland 21203-1715

3. 7.2 Delete this paragraph.

4. 7.4. A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program shall be used for performing the economic calculations for ECIP and non-ECIP ECOs. The AE may wish to obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977.

5. 7.5.1.2. Delete all references and requirements for a Project Development Brochure (PDB) from this study.

6. 7.5.2. The fiscal year to which all projects should be estimated for programming or implementation documents shall be determined at the interim review conference.

7. 7.6. Add the following schedule requirements: The work and services to be provided by the contractor under this contract shall be performed within the indicated number of calendar days:

a.	NTP to Interim Submittal Report	122 Days
b.	Interim Report Conference	163 Days
c.	Interim Approval	164 Days
d.	Prefinal Submittal	250 Days
e.	Prefinal Report Conference	293 Days
f.	Prefinal Approval	294 Days
g.	Final Submittal	324 Days

8. 7.6.3. All calculations for the final report shall be submitted on a spreadsheet format on floppy disk. The format will be ms-dos. The final report to the using agency shall consist of three hard copies and two 5 1/2 inch floppy disks.

9. 7.6.4. Submittals of reports and minutes shall be transmitted directly to the agencies listed below in the quantities noted. An informational copy of all transmittal letters, shall be provided to NAB: None

Agency	Reports	Minutes
USALEA, DALO-LEP	A	---
USACE, CEEC-EE	A	---
CEHND-ED-PM - No. Deleted at startup	3	1
CENAB-EN-IM	3	2
CENAD-EN-TM	A	1
HQ, TRADOC, ATEN-FE	1	1
ATZF-DEH	5	1

Submittals will be mailed to:

"A" - Executive Summary Only

COMMANDER
USALEA
ATTN: DALO-LEP (Mr. Keath)
NCAD
New Cumberland, PA 17070-5007

COMMANDER
HQ USACE
ATTN: CEEC-EE (Mr. Beranek)
Washington, DC 20314

COMMANDER
USAED, Huntsville
ATTN: CEHND-ED-PM (Mr. Ganus)
P.O. Box 1600 - West Station
Huntsville, AL 35807-4301

COMMANDER
US Army Corps of Engineers
Baltimore District
ATTN: CENAB-EN-IM (Mr. Hawk)
P.O. Box 1715
Baltimore, MD 21203-1715

COMMANDER
USAED, North Atlantic
ATTN: CENAD-EN-TM (Mr. Cosenza)
90 Church Street
New York, NY 10007

COMMANDER
HQ TRADOC
ATTN: ATEN-FE-((Mr. Browe)
Fort Monroe, VA 23651

COMMANDER
US Army Transportation Center
and Fort Eustis
ATTN: ATZF-DEH (Mr. Chenkin)
Fort Eustis, VA 23604-5332

10. The buildings and ECOs to be surveyed are grouped on four matrices designated priorities 1, 2, 3, 4. The buildings and systems listed on the matrixes shall be investigated. Results of surveys and evaluations shall be extrapolated to include all duplicate facilities as indicated. A negotiated price will be reached for each priority for most effective use of Government funds. Identification of the duplicate facilities, characteristics of usage and size can be obtained from Ft. Eustis. Clarification notes for the ECOs are as follows:

a. Intended scopes of investigation for lighting ECOS are:

1. Light Intensity Controls - Study florescent Light Intensity Control System including (FLICS) as well as energy saving fluorescent lamps and ballasts.

2. Light Level Controls - Study control of non-fluorescent lighting levels such as shut off with electric eye, etc.

3. Lighting - Study use of more efficient lighting such as replacement of incandescent lights, etc.

b. Dual Fuel: The two fuel choices are fuel oil and natural gas.

c. Heat Pumps: Maintaining the existing heat pumps is very difficult. Most of the heat obtained in these buildings is provided by auxiliary electric strip heaters. Evaluation should consider replacement of these heat pumps by unit oil-fired furnaces.

d. Windows: The existing storm and prime windows, are large and difficult to operate and close properly. AE should evaluate replacing these windows with double-pane, thermal-break windows. At the least, provide a minimum pay-back period on the storm windows (installed in 1978), so they may be replaced with AFH M&R funds at that time.

e. Modular Offices: Offices that have been built inside of existing warehouses shall be evaluated to determine if these offices continue to generate energy savings compared to heating & cooling the complete building they occupy.

f. Temporary Buildings: These buildings shall be studied under this project, but not included in any ECIP project. However, they will be included in other types of projects.

g. Steam Distribution: Study the complete steam distribution system that is serviced from Bldg 414 as noted on Drawing 18-02-25 dated July 86. This study includes insulation, condensate returns, shut off valves, steam traps, lower pressure in summer and using hot water in lieu of steam.

Items of Study	Ceiling Insulation	Ceiling Plenum Ducts	Light Intensity Control	Wall Insulation	Solar Heat/Hot Water	Improve Power Factor	Solar Film	Vestibules	Dual Fuel	High Efficiency Motors	Infrared Heaters	Shower Flow Restrictors	Steam Distribution	Windows	Hanger Door Weatherstrip	Light Level Controls	Lighting	Doors	Heat Reclamation	Modular Offices	FUEL OIL	Building No.	Dupl. Bldg. No.	Priority
							X																	
				X																		Boiler Plants	11	1
																						Electrical Dist.		
X	X																					401		
		X							X													643		
X									X													664 ✓	4	
	X																					705		
X	X								X													812	5	
																						1001	8	
		X						X		X												2715 X		
		X						X		X												2716 ✓		
																				X		801 ✓		
										X												414		

DUPLICATE BUILDING NUMBER LIST

4. Bldg # 661
   3 Dupl Bldgs: 662, 663, 664

5. Bldg # 809
   15 Dupl Bldgs: 802, 803, 804, 805, 808, 810, 811, 812, 813, 814, 815, 817, 818, 819, 820

8. Bldg # 1001
   3 Dupl Bldgs: 1002, 1003, 1004

(11) Boiler Plants
Bldgs #-195, 227, 409, 414, 705, 801, 1411, 1606, 2116, 2406, 2701, 2719, 2750, General Heating Map (Main Post, Felker Airfield)

Item of Study	Shower Flow Restrictor	Wall Insulation	Ceiling Insulation	Windows	Heat Pumps	Building No.	Duke Bldg. Priority
	X	X	X	X		304	A
	X	X	X	X		152	B
	X	X	X	X		1920	C
	X	X	X	X		2102	D
			X			122	E

DUPLICATE BUILDING NUMBER 7 ISN'T

A. Bldg # 304, Group 10
8 Similar Groups: 3, 4, 7, 8, 9, 11, 12, 13

B. Bldg # 152, Group 2
10 Similar Groups: 1, 24, 25, 26, 27, 28, 29, 30, 31, 32

C. Bldg # 1920, Group 5
4 Similar Groups: 14, 15, 19, 20

D. Bldg # 2102, Group 22
6 Similar Groups: 6, 16, 17, 18, 21, 23

E. Heat Pump
Bldgs # 109, 110, 122, 133, 155 - 179

SEE PAGES A-7 - A-9 FOR DUPLICATE BUILDINGS IN EACH GROUP

PRIORITY #2 - Sheet 2

GROUP #

1. Bldg # 123 (ACWH NCO-ENL)
   6 Dupl Bldgs: 121, 133, 135, 138, 166, 173

2. Bldg # 152 (ACWH NCO-ENL)
   5 Dupl Bldgs: 105, 108, 111, 149, 177

3. Bldg # 1104 (FH CAPE CG&WO)
   9 Dupl Bldgs: 1105, 1106, 1116, 1118, 2527, 2530, 2566, 2567, 2568

4. Bldg # 1107 (FH CAPE CG&WO)
   13 Dupl Bldgs: 1108, 1110, 1112, 1115, 1117, 1119, 2513, 2514, 2528, 2560, 2562, 2564, 2565

5. Bldg # 1920 (FH CAP CG&WO)
   27 Dupl Bldgs: 1921, 1922, 1923, 1924, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1938, 1939, 1944, 1945, 1953, 1961, 1963, 1965, 1972, 1974, 1980, 1982, 1984, 1986, 1988, 1990

6. Bldg # 2101 (FH CG & WO)
   5 Dupl Bldgs: 2103, 2104, 2105, 2107, 2120

7. Bldg # 302 CAPE NCO-ENL
   16 Dupl Bldgs: 303, 315, 319, 322, 323, 342, 350, 2305, 2307, 2322, 2324, 2332, 2341, 2353, 2356, 2358

8. Bldg # 308 CAPE NCO-ENL
   9 Dupl Bldgs: 311, 341, 2304, 2308, 2309, 2312, 2331, 2339, 2357

9. Bldg # 305 CAPE NCO-ENL
   5 Dupl Bldgs: 307, 310, 349, 2311, 2321

10. Bldg # 304 CAPE NCO-ENL
    23 Dupl Bldgs: 306, 309, 312, 317, 318, 327, 328, 330, 331, 334, 335, 338, 339, 346, 348, 2306, 2310, 2320, 2323, 2330, 2340, 2354, 2355

11. Bldg # 1109 FH CAPE CG&WO
    5 Dupl Bldgs: 1120, 2512, 2529, 2543, 2561

12. Bldg # 1111 FH CAPE CG&WO
    3 Dupl Bldgs: 1113, 1114, 2563

13. Bldg # 2936 CAPE LE & MJ
    14 Dupl Bldgs: 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2949, 2950

14. Bldg # 2316 CAPE NCO-ENL
    3 Dupl Bldgs: 2317, 2335, 2336

PRIORITY #2 - Sheet 3

GROUP #

15. Bldg # 1972 FH CAP CG&WO
    3 Dupl Bldgs: 1974, 1976, 1978

16. Bldg # 2313 CAPE NCO-ENL
    3 Dupl Bldgs: 2319, 2333, 2345

17. Bldg # 2314 CAPE NCO-ENL
    5 Dupl Bldgs: 2325, 2327, 2315, 2318, 2326

18. Bldg # 2301 CAPE NCO-ENL
    4 Dupl Bldgs: 2334, 2342, 2343, 2344

19. Bldg # 2300 CAPE NCO-ENL
    30 Dupl Bldgs: 2302, 2303, 2328, 2329, 2337, 2338,
    2360, 2361, 2362, 2364, 2365, 2366,
    2368, 2369, 2370, 2372, 2376, 2377,
    2378, 2379, 2380, 2381, 2382, 2383,
    2384, 2385, 2390, 2391, 2392, 2393

20. Bldg # 2760 CAPE LC&Mj
    22 Dupl Bldgs: 2761, 2762, 2763, 2764, 2765, 2766,
    2767, 2768, 2769, 2770, 2771, 2772,
    2773, 2774, 2775, 2776, 2777, 2778,
    2779, 2780, 2781, 2782

21. Bldg # 2927 COL-FH
    7 Dupl Bldgs: 2925, 2926, 2928, 2932, 2933, 2934, 2935

22. Bldg # 2102 FH CG&WO
    6 Dupl Bldgs: 2106, 2108, 2118, 2119, 2121, 2122

23. Bldg # 2929 COL-

24. Bldg # 104 ACWH NCO-ENL
    4 Dupl Bldgs: 109, 110, 157, 119

25. Bldg # 164 ACWH NCO-ENL
    1 Dupl Bldg: 176

26. Bldg # 102 ACWH NCO-ENL
    5 Dupl Bldgs: 148, 118, 120, 131, 132

27. Bldg # 155 ACWH NCO-ENL
    4 Dupl Bldgs: 160, 169, 170, 179

28. Bldg # 103 ACWH NCO-ENL
    4 Dupl Bldgs: 162, 113, 128, 129

29. Bldg # 154 ACWH NCO-ENL
    5 Dupl Bldgs: 156, 165, 168, 171, 174

30. Bldg # 159 ACWH NCO-ENL
    5 Dupl Bldgs: 161, 115, 124, 127, 134

PRIORITY # 2 - Sheet 4
GROUP #4

31. Bldg # 106 ACWH NCO-ENL
    7 Dupl Bldgs: 150, 114, 116, 122, 125, 136, 178

32. Bldg # 111 ACWH NCO-ENL

Items of Study	Ceilings Insul.	Ceilings Plenum Ducts	Light Intensity Control	Wall Insulation	Solar Heat/Hot Water	Skylights/Solar Power Factor	Solar Film	Vestibules	Dual Fuel	High Efficiency Motors	Infrared Heaters	Shower Flow Restrictors	Steam Distribution	Windows	Manager Door Weatherstrip	Light Level Controls	Lighting	Doors	Heat Reclamation	Modular Offices	Building No.	Dupl. Bldg. No. Priority
			X										X				X				403	3
X			X																		409	
X			X										X				X				421	
			X																		861	
			X																		833	7
			X																		823	6
X		X	X																		1405	
X		X	X																		1406	
X		X	X			X															1407	
X		X	X																		1410	
			X																		2401	
			X						X				X								2402 (Main, Wing	
												X									2407	
			X						X				X		X						2411	
			X																		2411 (Classroom	
X																					2418	
			X						X			X		X							2406	
X			X									X									2408	
X			X									X	X		X	X					2413	
	X	X																			2730	
					X	X															2785	10
			X																		2717	
			X																		2718	
												X									2719	
												X		X							2743	
			X									X									2750	
			X									X									2747	
															X						3301	
X													X		X						3302	
			X						X					X								3308	
			X						X				X								3306	
							X														Well/Chiller/Sewage	12

DUPLICATE BUILDING NUMBER LIST

(6) Bldg # 823
3 Dupl Bldgs: 667, 826, 1006.

(7) Bldg # 833
5 Dupl Bldgs: 665, 829, 830, 831, 1005

(10) Bldg # 2753
11 Dupl Bldgs: 2755, 2757, 2759, 2785, 2787, 2789, 2791, 2792, 2794, 2796, 2798

(12) Well Pump: Located at Hines Circle

Chillers
Bldgs # 705, 2116 D, 2115 D, 401, 923, 1384, 1386, 3308, 576, 2123, 650, 1001, 1003, 812(5), 664, 663 } each bld

Sewage Treatment Plant
Bldg # 1615,

Reduction is at 78%

Measures of Study	Building No.	Dupl. Bldg. No.	Priority
	214	1	4
X	231	2	
X	515		
X X	675		
X X	650		
X X	640		
X X	647		
X X	925		
X	923		
X	1012		
X X	1013		
X X	1028		
X X	1387		
X X	1605	9	
X X X	1608	9	
X	1733		
X	1721	3	
X	[illegible]	2	

Ceiling Insulation
Ceiling Plenum Ducts
Light Intensity Control
Wall Insulation
Solar Heat/Hot
Improve Power Fa
Solar Film
Vestibules
Dual Fuel
High Efficiency Motors
Infrared Heaters
Shower Flow Restrictors
Steam Distribution
Windows
Hanger Door Wea
Light Level Controls
Lighting
Doors
Heat Reclamation
Modular Offices
Temporary Buildings

DUPLICATE BUILDING NUMBER LIST

1. Bldg # 214
   1 Dupl Bldg: 215

2. Bldg # 231
   7 Dupl Bldgs: 201, 202, 203, 204, 205, 232, 343

3. Bld # 1721
   35 Dupl Bldgs: 627, 628, 630, 632, 710, 711, 1015, 1018, 1513, 1514, 1518, 1522, 1523, 1528, 1529, 1533, 1534, 1540, 1542, 1549, 1557, 1706, 1707, 1711, 1712, 1717, 1719, 1725, 1728, 1734, 1740, 1745, 1747, 1748, 1749

9. Bldg # 1608
   3 Dupl Bldgs: 1605, 1607, 1610

INTERIM

REVIEW

COMMENTS

TO (Name)	OFFICE SYMBOL	TELEPHONE NO.	# PAGES	PRECEDENCE	DTG
Chuck [redacted]uson	Chief Mech Engr	717-703 7397	1	Normal	20 Mar 90

BALTIMORE DISTRICT REVIEW COMMENTS, ENGR. DIVISION

PROJECT ESOS- FT. EUSTIS LOCATION FT. EUSTIS, VA. DATE 14 MAR 90

TYPE ☐ CONCEPT ☐ PRELIMINARY ☐ FINAL ☐ BACK CHECK ☒ OTHER (SPECIFY) INTERIM

DISCIPLINE REVIEWED MECHANICAL REVIEWER R. BUTTLES PAGE 1 OF 3

ITEM NO.	LOCATION OF COMMENT	COMMENTS	ACTION TAKEN BY DESIGNER
1	Scope of Work	Please review the scope of work required for an interim submittal. Work should have been prepared in 3 ring binders. The A-E should have submitted the Scope of Work as part of this submittal. The methods used should have been provided with each ECO. (e.g. Lighting Intensity Controls should have discussed all the options that were looked at as part of the L.I.C. ECO and then discussed how each option was modeled, that is what changes were made to the base run to calculate each options energy savings potential) See attached sheet from a previous ECIP project for the type of information desired for each type of ECO. See Annex C for additional executive summary information requirements.	
2	Executive Summary Page 7	Infiltration characteristics will also be guided by building air balance. Buildings requiring higher amounts of outside air for personnel ventilation requirements than for building exhaust + air requirements will not realize the energy savings projected by tightening the building. Please check the buildings for these conditions as it will impact the potential energy savings.	

NAB Form 1331
REV. 06 AUG 87

NOTE: ALL COMMENTS ARE TO BE LEGIBLE AND TO THE POINT.

BALTIMORE DISTRICT REVIEW COMMENTS, ENGR. DIVISION

PROJECT ESOS - FT. EUSTIS LOCATION FT. EUSTIS, VA. DATE 14 MAR 90

TYPE ☐ CONCEPT ☐ PRELIMINARY ☐ FINAL ☐ BACK CHECK ☒ OTHER (SPECIFY) INTERIM

DISCIPLINE REVIEWED MECHANICAL REVIEWER R. BUTTLES PAGE 2 OF 3

ITEM NO.	LOCATION OF COMMENT	COMMENTS	ACTION TAKEN BY DESIGNER
3	Appendix B	Mechanical, List what each building is used for, as noted on architectural notes. List unoccupied cooling temperature setpoint.	
4	General	In Executive Summary discuss how synergism between multiple ECO's for the same building is being handled.	
5	Appendix F Volume 1 Bldg 812	Base building shows 0% infiltration, Heat exchanger Shows 5000 cfm cooling/heating ventilation. These two building simulations are not compatible.	
6	Appendix F Volume 3 Bldg 27150	Explain what the difference between schedules APHTX and AA55 is for I.R. Heater ECO. As shown it does not appear Trane Ultra can model Infra-red Heaters. Confirm this with Trane and respond as to the adviseability of this approach.	
7	Appendix F	Each building in Appendix F should have a separate input sheet for each ECO being modeled showing exactly what changes are made to the program input base run to model that particular ECO. This will allow the input files to be reviewed more closely.	

NAB Form 1331
REV. 06 AUG 87

NOTE: ALL COMMENTS ARE TO BE LEGIBLE AND TO THE POINT.

BALTIMORE DISTRICT REVIEW COMMENTS, ENGR. DIVISION

PROJECT ESOS - FT. EUSTIS LOCATION FT. EUSTIS, VA. DATE 14 MAR 90

TYPE ☐ CONCEPT ☐ PRELIMINARY ☐ FINAL ☐ BACK CHECK ☒ OTHER (SPECIFY) INTERIM

DISCIPLINE REVIEWED MECHANICAL REVIEWER R. BUTTLES PAGE 3 OF 3

ITEM NO.	LOCATION OF COMMENT	COMMENTS	ACTION TAKEN BY DESIGNER
8	Appendix H	LIBPPL schedule, Confirm for schedule that Starting Day Type and Ending Day Type can both be noted as "DSGN."	
9	General Executive Summary	For electric lighting ECO's discuss all ECO's and what they would do. It appears the lighting ECO's all dealt with lighting levels. There are other options, such as timers, sensors, provide specialized task lighting, zoning, more efficient lamping, ballasts, etc. These should be discussed.	
10	Appendix G	Explain how boiler efficiencies and piping line losses were determined.	
11	Appendix G	Provide narrative discussing: steam system summary methodology and narrative of what file outputs provided mean.	
12	Appendix A	No maintenance costs are noted for any ECOs. This should be reviewed and maintenance costs included for the years when they occur.	

NAB Form 1331

NOTE: ALL COMMENTS ARE TO BE LEGIBLE AND TO THE POINT.

BALTIMORE CORPS OF ENGINEERS COMMENTS

1. COE Comment No. 1 - Page 1 of 3:

   Three ring binders are being supplied for the prefinal submission. The Scope of Work is included in the prefinal submission. The methodology used for all ECO's is addressed throughout the report.

2. COE Comment No. 2 - Page 1 of 3:

   Thermal loading due to building infiltration is totally independent of the building air balance. If a building has 1,100 CFM of outside air on the main air system and 1,000 CFM of direct exhaust, the 100 CFM is being blown out of the building cracks in the process of building pressurization. Building pressurization is normally accomplished at approximately 0.025" WC positive pressure relative to atmosphere. Whenever pressurization air is used it is heated or cooled to space conditions prior to being blown out through building cracks. Given the above described building, if one-half of the crack area were eliminated only 50 CFM of outside air would be required to pressurize the space.

   The only real difference between energy for normal infiltration and energy for pressurization is where the heat transfer takes place. When the conditions permit actual infiltration, the heat transfer takes place in the space with an offsetting energy input at the central system. When the space is pressurized to avoid infiltration, all direct energy transfer occurs at the central system with conditioned air being blown out through building cracks.

3. COE Comment No. 3 - Page 2 of 3:

   Corrected mechanical survey sheets, refer to Appendix B.

4. COE Comment No. 4 - Page 2 of 3:

   In accordance with scope of work direction on studying, synergism is to be provided to the A/E between interim and prefinal reports. A/E past experience has been that synergism is reevaluated when two or more energy conservation opportunities have SIRs greater than one. A/E believes the following facilities are subject to study of synergistic energy effects:

   - Building 2102
   - Building 2402
   - Building 2413
   - Building 3302
   - Building 3308

   Upon receipt of further direction and clarification with scope requirements to study synergistic effects of multiple viable energy conservation opportunities.

5. COE Comment No. 5 - Page 2 of 3:

Building 812 is a barracks. In the original Scope of Work, ceiling insulation and lighting intensity control were to be studied. During the field survey, the survey team discovered that the Commissary, Building 1605, is in the process of being relocated to a new facility. The A/E agreed to investigate the concept of air to air heat exchangers in Building 812, Barracks, in lieu of studying heat reclamation at the Commissary.

When the A/E agreed to study air to air heat exchangers for Building 812, the base run had already been completed. During field survey of Building 812, the actual 5,000 CFM ventilation system was disabled. The second set of runs associated with Building 812 start with the assumption that if the ventilation were actually provided we would generate an energy profile different from the energy profile that exists at present. After the baseline energy profile was established it was possible to study a comparative profile with air to air heat exchangers.

6. COE Comment No. 6 - Page 2 of 3:

Thermostat schedule ADHTX is set at 68°F dry bulb space temperature between 0700 hours and 1700 hours during weekdays, at all other times the setpoint temperature is 55°F.

Thermostat schedule AA55 is set at 55°F dry bulb 24 hours per day 7 days per week.

The Trane Trace Ultra Program does not have a system simulation package that directly models infrared heaters. The Trane Company does not have a standard model to simulate infrared heater systems.

The rationale for simulating infrared heaters in this manner is that as the heaters heat up the floor and furnishings, these items store thermal energy. As the thermal energy is stored, it is later released to the space causing secondary heating of the space. All studied facilities were treated with broad range coverage of IR heaters as no fixed work stations exist in any of the studied facilities. Under normal operating conditions in an IR heated building, the bulk space temperature approaches 55°F. Even if there is not an energy requirement to condition the space for occupants, minimal space heating is required to avoid freezing of building systems, i.e. sprinklers and water lines.

In addition to a reduction of heating required to maintain bulk temperature, IR heating requires less heating of infiltration air. Given the comparison of 55°F versus 68°F bulk air temperature, the energy savings per hour for 100 CFM of infiltration is 1,430 BTU/Hr.

The simulation method selected does not approximate the theoretically ideal conditions of IR heat controlled by black body thermostats. Simulation of IR heaters controlled by black body thermostats does not account for heat absorbed, stored, and released by building components and furnishings. Simulation of IR heaters controlled by black body

thermostats does not account for the override setting of IR used to maintain bulk space temperature to avoid freezing.

In view of the drawbacks associated with both methods of simulating IR heaters, the more conservative approach was selected so that no energy saving credits were not counted that cannot actually be anticipated.

7. COE Comment No. 7 - Page 2 of 3:

Computer input sheets have been marked up to identify what changes were made from alternative to alternative. (Refer to latest Appendix F, Volumes I and II.)

8. COE Comment No. 8 - Page 3 of 3:

A/E confirms that in this application, the starting day type and ending day type can be "DSGN". Refer to PPs 7 and 10 of the Utility Reference Manual for further details (pink cover).

9. COE Comment No. 9 - Page 3 of 3:

The Executive Summary and Report have been updated to address this comment.

Motion sensors and/or infrared sensors are generally designed for loads of less than 1000 watts. Larger loads can be controlled by adding relays or contactors. Several things make these devices have questionable value for Fort Eustis. In larger offices, modular office partitions have been installed and were being installed in more offices during this survey. These partitions tend to block the line of control for the sensors. In addition, military employees have a structure and discipline that can be used to keep lights off when areas are not in use. Admittedly, some people remain careless and do not turn lights off. It is difficult to predict how much energy can be saved by motion sensing devices but it must be far less than in similar civilian applications.

Timers and contactors have not been considered in many areas because of flexible schedules and the inherent military discipline which was discussed above.

10. COE Comment No. 10 - Page 3 of 3:

Boiler efficiency was determined by interviewing personnel at the Post Energy Branch. The Post stated that efficiency testing is periodically performed and boilers adjusted to maintain the highest possible efficiency. Energy Branch personnel indicated that most central plant boilers were adjusted to achieve "80% or higher efficiency". All efficiency testing is combustion efficiency. Combustion efficiency does not take into account radiation or conduction losses nor does this type testing account for the local preheating of combustion air. In view of the test results and observation of the operation a value of 80% efficiency for central plan was used for the purpose of the study.

Individual boilers are normally not as well maintained as central plant boilers. In the judgement of the field engineer, the observed conditions of individual boilers was somewhat less attended to than central plants. In view of the above observations, individual boilers, gas and oil, were assigned an efficiency of 70%.

The efficiency of the individual residential furnaces was established at 83.3% as this is an industry accepted standard value.

The value of 10% piping loss in the district steam systems was established as this is a common value used in the design of district steam systems.

11. COE Comment No. 11 - Page 3 of 3:

Pipe heat loss data is available in tabular form from various insulation manufacturers, all calculated in accordance with ASTM Standards. Weather data for Fort Eustis was provided by the Baltimore District Corps of Engineers. At each individual temperature and for each individual pipe size and for each individual pipe orientation quadratic curve fitting was performed to determine heat loss at specific conditions.

A typical file set is presented as follows:

Cover Sheet with Five Columns (See Attachment "A")

Column 1	Control Number
Column 2	Lineal Feet of Pipe
Column 3	200°F Heat Loss BTU/Hr.
Column 4	400°F Heat Loss BTU/Hr.
Column 5	600°F Heat Loss BTU/Hr.

This data was subsequently read into another program to evaluate annual heat loss.

Given the attached sample analysis, five pipe conditions exist. The first condition is a 1-1/2" pipe with 2-1/2" calcium silicate insulation in the horizontal position.

There are five data columns associated with this pipe condition. Column designations are as follows:

Column 1	Average Temperature of Outside Air Temperature Bin
Column 2	BTU/Hr. per Lineal Foot of Pipe if Heat is On
Column 3	Lineal Feet of Pipe
Column 4	Hours/Year at Given Bin Temperature Range
Column 5	BTU/Year Heat Loss for Given Pipe Section at Given Bin Temperature

The total system heat loss is given on the last page, 3.88×10^8 BTU/Yr. in the example presented.

12. COE Comment No. 12 - Page 3 of 3:

The majority of the ECOs studied dealt with insulation, added glazing and infiltration where maintenance costs do not apply. Maintenance costs have been used were they apply; example: heat pump studies.

ATTACHMENT "A"

HEAT LOSS PER HOUR PER FOOT PER. TABLES CALCULATED PER ASTM

		200°F	400°F	600°F
1	403	16	47	86
2	141	16	47	86
3	560	18	55	100
4	132	18	54	99
:	143	29	87	159

CONTROL NUMBER

LINEAL FEET OF PIPE

1-1/2"-2-1/2" C.S.-HORZ. ← PIPE CONDITION FOR CONTROL NUMBER 1

97	0	403	7	0
92	0	403	72	0
87	0	403	243	0
82	0	403	511	0
77	0	403	913	0
72	0	403	1069	0
67	37.64179	403	862	1.307623E+07
62	38.45353	403	806	1.24904E+07
57	39.26981	403	710	1.123627E+07
52	40.09065	403	672	1.085719E+07
47	40.91611	403	718	1.183924E+07
42	41.74623	403	742	1.248321E+07
37	42.58107	403	580	9952898
32	43.42066	403	441	7716851
27	44.26506	403	258	4602415
22	45.11431	403	109	1981736
17	45.96845	403	36	666910.3
12	46.82755	403	7	132100.5
7	47.69163	403	1	19219.73

Average temperature of bin

LINEAL FOOT OF PIPE

HOURS PER YEAR ~~AND~~ AT GIVEN BIN TEMPERATURE

BTU/YR AT GIVEN BIN TEMPERATURE

Curve fit generated heat loss at given pipe temperature and bin Average air temperature BTU/hr. ft

1-1/2"-2-1/2" C.S.-VERT.

97	0	141	7	0
92	0	141	72	0
7	0	141	243	0
82	0	141	511	0
77	0	141	913	0
72	0	141	1069	0
67	37.64179	141	862	4575058
62	38.45353	141	806	4370090
57	39.26981	141	710	3931300
52	40.09065	141	672	3798669
47	40.91611	141	718	4142265
42	41.74623	141	742	4367575
37	42.58107	141	580	3482280
32	43.42066	141	441	2699940
27	44.26506	141	258	1610274
22	45.11431	141	109	693361.8
17	45.96845	141	36	233335.9
12	46.82755	141	7	46218.79
7	47.69163	141	1	6724.52

2-1/2"-3" C.S.-HORZ.

97	0	560	7	0
92	0	560	72	0
87	0	560	243	0
82	0	560	511	0
77	0	560	913	0
72	0	560	1069	0
67	43.79637	560	862	2.114139E+07
62	44.7707	560	806	2.02077E+07
57	45.75017	560	710	1.819027E+07
52	46.73477	560	672	1.758723E+07
47	47.72447	560	718	1.918905E+07
42	48.71927	560	742	2.024383E+07
37	49.71916	560	580	1.614878E+07
32	50.72411	560	441	1.252683E+07
27	51.73412	560	258	7474546
22	52.74918	560	109	3219810
17	53.76926	560	36	1083988
12	54.79436	560	7	214793.9
7	55.82447	560	1	31261.7

2-1/2"-3" C.S.-VERT.

7	0	132	7	0
2	0	132	72	0
7	0	132	243	0
82	0	132	511	0
77	0	132	913	0
72	0	132	1069	0
67	43.08723	132	862	4902637
62	44.03388	132	806	4684852
57	44.98588	132	710	4216076
52	45.94325	132	672	4075350
47	46.90602	132	718	4445565
42	47.87423	132	742	4688994
37	48.8479	132	580	3739795
32	49.82704	132	441	2900532
27	50.81171	132	258	1730443
22	51.80191	132	109	745325.8
17	52.79767	132	36	250894.5
12	53.79903	132	7	49710.3
7	54.806	132	1	7234.392

5"-3" C.S.-HORZ.

97	0	143	7	0
92	0	143	72	0
87	0	143	243	0
82	0	143	511	0
77	0	143	913	0
72	0	143	1069	0
67	69.4439	143	862	8560072
62	70.96803	143	806	8179634
57	72.50058	143	710	7360983
52	74.04154	143	672	7115096
47	75.59096	143	718	7761227
42	77.1489	143	742	8185962
37	78.71537	143	580	6528653
32	80.29041	143	441	5063355
27	81.87406	143	258	3020661
22	83.46634	143	109	1300990
17	85.0673	143	36	437926.5
12	86.67697	143	7	86763.65
7	88.29538	143	1	12626.24

THE TOTAL ANNUAL HEAT LOSS IS 3.883226E+08 BTU

THE TOTAL ANNUAL HEAT LOSS IS 3883.226 THERMS

TOTAL BTU's AND THERMS PER YEAR FOR ENTIRE PIPE SYSTEM AS INPUT IN THIS SERIES

COMMENTS
ENERGY MANAGEMENT BRANCH, FORT EUSTIS, VA
ENERGY SAVINGS OPPORTUNITY SURVEY STUDY
INTERIM REPORT
26 MAR 90

1. Include in Executive Summary, energy and dollar savings, SIR's and simple paybacks as described in scope of work 7.6.1 Interim Submittal. Maybe some recommendations?

2. Executive Summary, Summary Report, give definitions/cover sheet of abbreviations. Complete columns for all buildings, not to say data taken from .... or similar to .....(example 2715 and 2716).

3. Priority 2, windows, what is the difference between windows and windows-Anderson?

4. What is CXL NOV 1, 89? Is there no energy savings there? What is the SIR? Same question for all the other CXL's. What is meant by 'DONE'. Do you mean that nothing can be done there? No energy savings at all?

5. You say bldgs 3308 and 3302 are over-lit and out of date. What are the energy and dollar savings, SIR's and simple paybacks? What is the solution? Include this in the Executive Summary.

6. DETERMINATION OF BUILDING INFILTRATION: How much energy loss is associated with infiltration? Executive Summary should contain numbers and solutions. Where and how you got your data and design assumptions should be in the back.

7. Demand peaks occur at Fort Eustis historically in June, July or August, depending on the year. What year did you use?

8. Page 9, Executive Summary, Does infrared heating really maintain occupant comfort?

9. What is meant by, 'Installation of infrared heating systems in some hangers may limit the flexibility of use of these hangers in the future.'? Can these infrared units be installed on the walls out of the way? Please explain.

10. Steam Distribution System bldg 414, what about conclusions on condensate return, shut off valves, steam traps, lower pressure in summer and using hot water in lieu of steam? Scope of Work A-4. All I see is insulation? Bldg 414 is a winter only plant, what impact on the ECO would this be on a year around plant?

11. APPENDIX B, FIELD SURVEY NOTES, include data for heat pump for Bldg 152 type buildings to back up computer run.

12. Where is 2716 A-0? These High Bay areas are somewhat different than 2715. Complete these computer runs Summary

FROM (Name) J. Hawk | OFFICE SYMBOL Corps of Engrs
TO (Name) Chuck Johnson | OFFICE SYMBOL Chief, Mech Engr | TELEPHONE NO. 804-962-3778
TELEPHONE NO. 717-763-7397 | # PAGES 4 | RELEASER'S SIGNATURE J. Hawk
PRECEDENCE Normal | DTG 26 Mar 90
FORM

Report for all.

13. 'Ceiling insulation already installed.' How much? Is it enough? Is it old or wet?

14. Summary Report: 2413 doors done. What do you mean? Is there anything better that can be used than what is there?

15. How do you get negative SIR's on wall and ceiling insulation?

16. Bldg 1608, Modular Offices, shows a very low SIR. Why? Please check again.

17. Vestibules Bldg 2785 shows a SIR of 0? Why? Please check again.

18. Do documentation according to Scope of Work page 5, 5.3.

19. Field House, Bldg 643, is shown to be occupied between 10 AM and 10 PM. Their hours are 5 AM to 10 PM Monday thru Friday and 9 AM to 8:30 PM Saturday and Sunday. Classes are held in the morning, lap swimming from noon until 1 PM and open swimming there after. The showers are used all day long. Hand ball courts and weight rooms are open all day long.

20. Appendix D, you are designing furnace for Bldg 152 at 150,000 btu/hr. This is rather large. How did you size this? We would like to run this ECO for a package unit, natural gas and condensing unit. The cost of doing the gas versus oil is vastly less when eliminating the oil storage tanks. This could be a replacement for any of those that were cancelled.

21. How about some better binders? There is too much material for these flimsy binders.

22. I would like to see all sketches, estimates, analysis and computer runs for each building put together, not pieces all spread out.

23. Bldg 304, does both the brick and aluminum siding have wall insulation?

24. Explain Executive Summary, pg 5, 'camel hump effect'. Should classrooms have occupancy sensors?

25. Executive Summary, pg 3, fuel costs should be presented without efficiencies. Leave the efficiencies in the equipment.

COMMENTS BY FORT EUSTIS PERSONNEL

1. Fort Eustis Comment No. 1 - Page 1 of 2:

   Dollar saving and energy saving columns have been added to summary report as agreed during interim submittal on board review.

2. Fort Eustis Comment No. 2 - Page 1 of 2:

   Summary report has been enhanced and expanded relative to buildings in the 2715 series. A table of specific notes has been added to the summary report to clarify variances. Also see response to Comment No. 12.

3. Fort Eustis Comment No. 3 - Page 1 of 2:

   Scheme 1 is to remove all exterior windows and replace them with Anderson insulated units.

   Scheme 2 is a less costly approach which only replaces single glazing in existing Anderson windows with insulated glazing.

4. Fort Eustis Comment No. 4 - Page 1 of 2:

   Explanatory notes have been added to summary report to clarify the status of various conditions encountered during the field survey or during preparation of the report.

5. Fort Eustis Comment No. 5 - Page 1 of 2:

   This general statement is true and intended to alert Fort Eustis personnel to other buildings on the Base that may have this same type of lighting system. All lighting ECOs are documented in the executive summary charts.

6. Fort Eustis Comment No. 6 - Page 1 of 2:

   Infiltration is not broken out into a line items component of energy unless it is the only item of study for an ECO. For example: with a window replacement, infiltration energy is only a part of the total energy saved.

7. Fort Eustis Comment No. 7 - Page 1 of 2:

   Demand profile used in this report is based on data provided by Fort Eustis Energy Branch. Demand profile data was extracted from bill as presented in Appendix G.

8. Fort Eustis Comments No. 8 and No. 9 - Page 1 of 2:

   Properly designed and installed infrared heating systems have been proven to provide a comfortable environment for occupants. In some cases these systems are preferred over conventional systems.

These systems are designed to warm all objects in their line of sight including occupants, building surfaces and objects within the conditioned space. These warm objects, in turn, heat the surrounding air. Since occupants are heated directly with radiant heat, they feel comfortable at reduced room air temperatures. These systems work especially well in large open areas where the occupants are working on concrete floors which are warmed by the radiant heat.

Radiant heating systems do not apply to all type of work areas. In office areas and classrooms where sedentary work is performed, areas beneath desks are shaded from the radiant heaters and occupants will be uncomfortable due to the cold floors. This same scenario would apply to large areas where maintenance is being performed on the underside of large equipment.

10. Fort Eustis Comment No. 10 - Page 1 of 2:

Condensate loss and/or pass through are considered maintenance items and these losses can be reduced through proper maintenance of traps and valves and leak repair of piping systems. Lowering steam pressures and conversion to hot water are part of this study.

11. Fort Eustis Comment No. 11 - Page 1 of 2:

Heat pump data for Building 152 was proviced by Energy Branch at Fort Eustis. Heat pump data is presently misplaced. If Energy Branch will provide a duplicate copy of the heat pump data, A/E will incorporate data in final report.

12. Fort Eustis Comment No. 12 - Page 1 of 2:

Scope of Work permits computer simulation of similar buildings to determine viability of specific energy conservation opportunities. Of all the energy conservation opportunities studied relative to 2715 and 2716 Buildings, only IR heaters in 2715A with an SIR of 1.07. Columns for 2715 series buildings where definitive data is available; however, annual energy and dollar values vary from building to building and this data has not been extrapolated from calculated data. No data has been presented relative to 2716 series buildings as study of 2715 series building demonstrated significant energy savings will not be achieved given the energy conservation opportunities evaluated.

13. Fort Eustis Comment No. 13 - Page 2 of 2:

Comment refers to Building 2418 per reviewer clarification during interim review conference. Ceiling insulation is nominal 6" fiberglass batt and is in excellent condition as building is relatively new. The addition of insulation will not be cost effective, also refer to results of Building 401.

14. Fort Eustis Comment No. 14 - Page 2 of 2:

Refer to field survey notes under Architectural, doors, 2413 Hangar. The northern most section of the west hangar door was observed on 4 Oct 89. The door sheet metal covering joints were separated. Field surveyors observed insulation in the door panel. Insulation appeared to be the full width of the installed door. It is not possible to place more insulation in the observed door section. If the government wishes to core bore a few doors at various locations to document the typical door section, then the information necessary for a practical comparison of energy consumption can be modeled.

15. Fort Eustis Comment No. 15 - Page 2 of 2:

This comment refers to Building 1387, Telephone Exchange, as clarified during interim review conference. This facility is in operation 24 hours a day, 365 days a year. This facility is a telephone exchange with high internal heat gains. Based on the high internal gains, this building is rejecting heat when most other facilities are in the heating mode. There are conditions under which mechanical cooling is occurring in Building 1387 when other facilities are receiving heat. The addition of insulation to this facility will actually retain heat and require more internal cooling of the space to dissipate the retained heat.

16. Fort Eustis Comment No. 16 - Page 2 of 2:

Modular offices at Fort Eustis are a large waste of energy because of the large volumes (20 to 25 feet high) that must be heated and cooled to satisfy the occupants of a lower volume (7 to 8 feet high). The reason that this option is not feasible is that these areas must be almost totally reconstructed at high cost to limit the conditioned space to occupied level of 8 feet ceiling height.

17. Fort Eustis Comment No. 17 - Page 2 of 2:

Building 2785 vestibules have been reevaluated, refer to Appendix A and Appendix F-II. On reevaluation, maximum door infiltration was assumed and simulated. On comparison, the assumption was that addition of a vestibule would eliminate all infiltration. Vestibule addition at Building 2785 is still not economically feasible. Construction cost is $3,000 per door. The prohibitive first cost makes it impossible to have an acceptable payback of energy costs. The initial construction cost is very high because the vestibule cannot be placed inside the building and the present landing is not large enough to accommodate a vestibule. If a new vestibule is to be added, the existing landing slab must be removed and replaced to accommodate the installation of a functional vestibule.

18. Fort Eustis Comment No. 18 - Page 2 of 2:

We will comply with this comment.

19. Fort Eustis Comment No. 19 - Page 2 of 2:

Energy analysis and SOLFEAS have been reevaluated with the revised schedule indicated in the review comments. The original schedule that was used for interim submittal was based on information provided by the Office of the Field House.

20. Fort Eustis Comment No. 20 - Page 2 of 2:

Furnace size has been corrected and estimate has been updated. As requested, an additional evaluation has been performed to investigate replacement of existing heat pump systems, where they occur, with gas fired furnaces. Replacement energy costs at Fort Eustis are relatively low and an entire heating system must be replaced to convert the system to gas fired or oil fired capability.

21. Fort Eustis Comment No. 21 - Page 2 of 2:

We will comply with this comment.

22. Fort Eustis Comment No. 22 - Page 2 of 2:

Scope of Work does not require any specific order of appendices or data contained therein. Appendix system was set up for continuity of data generation and reproduction of documents. Changing format at this stage of production would create a significant source of errors. A/E does not believe changing format during production is prudent. A/E will rearrange one set of documents for Fort Eustis Energy Branch upon acceptance of final report submittal.

23. Fort Eustis Comment No. 23 - Page 2 of 2:

Sketch AS-304.01 has been updated to clarify insulation on brick and aluminum sided section. Brick and aluminum sided sections are insulated.

24. Fort Eustis Comment No. 24 - Page 2 of 2:

Motion sensors and/or infrared sensors are generally designed for loads of less than 1000 watts. Larger loads can be controlled by adding relays or contactors. Several things make these devices have questionable value for Fort Eustis. In larger offices, modular office partitions have been installed and were being installed in more offices during this survey. These partitions tend to block the line of control for the sensors. In addition, military employees have a structure and discipline that can be used to keep lights off when areas are not in use. Admittedly, some people remain careless and do not turn lights off. It is difficult to predict how much energy can be saved by motion sensing devices but it must be far less than in similar civilian applications.

25. Fort Eustis Comment No. 25 - Page 2 of 2:

Raw fuel costs have been placed in executive summary. As used terminal fuel costs are addressed in Appendix G.